

**Project Manual:
Divisions 0 - 33**

RICHMOND COMMUNITY SCHOOLS

RICHMOND HIGH SCHOOL MECHANICAL MODERNIZATION PROJECT

OWNER:

**Richmond Community Schools
300 Hub Etchison Parkway
Richmond, Indiana 47374**

Architect:

**LWC Inc.
712 East Main Street
Richmond, Indiana 47374
(765) 966-3546 Fax (765) 962-9195**

DATE: August 27, 2021

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BIDDING AND CONTRACT REQUIREMENTS

RICHMOND COMMUNITY SCHOOLS
300 Hub Etchison Parkway
Richmond, IN 47374

NOTICE TO BIDDERS

The Richmond Community Schools of Richmond, Indiana, will receive bids for **Richmond High School Second Mechanical Modernization Project** up to 3:00 p.m., prevailing local time, September 24, 2021, at the School Administration Building, 300 Hub Etchison Parkway, Richmond, Indiana. All bids must be filed on the required non-collusion affidavit properly signed and executed as evidence of financial responsibility and filed with Karen Scalf, Chief Financial Officer, of Richmond Community Schools at 300 Hub Etchison Parkway, Richmond, Indiana 47374. Each bidder shall submit either a bond, money order, cashier's check or certified check for five percent (5%) of the amount of the bid, made payable to Richmond Community Schools. Facsimile delivered bid forms will not be accepted. All bids must be made in compliance with the laws governing such matters and the Board of School Trustees reserves the right to reject any or all bids or to accept the lowest responsible and responsive bid, not necessarily the low bid, or to accept bids on one or more separate items. Detailed specifications and bidding procedures for bidders may be downloaded from LWC's FTP site starting August 27, 2021. Instruction to access the documents can be provided by emailing Sherry Jeffers at sjeffers@lwcinspires.com.

BOARD OF SCHOOL TRUSTEES
RICHMOND COMMUNITY SCHOOLS

Mr. John Weber, President
Mr. Jeff Slifer, Vice-President
Ms. Nicole Stults, Secretary
Ms. Kristen Brunton, Member
Mr. Keith Morey, Member
Mr. Aaron Stevens, Member
Mr. Brad Walton, Member

SECTION 000100 - INSTRUCTIONS TO BIDDERS

Sealed bids for the Richmond High School Mechanical Modernization will be received by the Richmond Community Schools (hereinafter referred to as the "Owner") at the Richmond Community School's Board Room, 300 Hub Etchison Parkway, Richmond, Indiana 47374 until 3:00 P.M. local Time, on September 24, 2021. The bids shall be noted for date and time upon receipt. Bids received after said time but during the bid opening meeting shall be noted with time of receipt, opened, and publicly read aloud, and thereafter handled by the Owner as required by applicable law.

Complete and detailed bidding documents for this work are on file and may be examined by prospective bidders at the following places:

LWC, Inc.
712 East Main Street
Richmond, Indiana 47374
(765) 966-3546
Fax (765) 962-9195

On Line
LWC's FTP
Contact Sherry Jeffers by email:
sjeffers@lwcinspires.com

Department of Building and Grounds
Richmond Community Schools
302 North 7th Street
Richmond, Indiana 47374

1. **INTERPRETATION:**

No oral interpretation will be made to any bidder as to the meaning of the Specifications. Every request for such an interpretation shall be made in writing and addressed to LWC, Inc., 712 East Main Street, Richmond, Indiana 47374 or by email to Kevin R. McCurdy, kmccurdy@lwcinspires.com. No inquiry received within ten (10) days of the date fixed for opening of bids will be given consideration. Every interpretation made to a bidder will be in the form of an Addendum to the Specifications, which, if issued, will be emailed to all prospective bidders (at the respective addresses furnished for such purposes) not later than seventy-two (72) hours prior to the date fixed for the opening of bids. Failure of any bidder to receive any such Addenda or interpretation shall not relieve any bidder from any obligation under his bid as submitted. All Addenda so issued shall become part of the Contract Documents. Receipt of each Addendum must be acknowledged on the Bid Proposal Form.

2. **EXAMINATION OF SITE, SPECIFICATIONS, ETC.:**

Each bidder shall visit the site of the proposed work and fully acquaint himself with conditions as they exist, so he may fully understand the facilities, difficulties and restrictions attending the execution of the work under this Contract. Bidders shall also thoroughly examine and be familiar with the Specifications. The failure or omission of any bidder to receive or examine any form,

instrument or document, or to visit the site and acquaint himself with conditions there existing shall, in no way, relieve any bidder from any obligations with respect to his bid.

By submitting a bid, the bidder agrees that he has examined the site, the Specifications, all other bidding documents and, where the Specifications require, a given result to be produced in any part of the Work, that the Specifications are adequate and the required result can be produced under the Specifications.

No claim for any extra will be allowed because of alleged impossibilities in the production of the results specified or because of inadequate or improper Drawings and Specifications.

Pre-bid Meeting will be held prior to the bid due date. A meeting will be held on Monday September 07, 2021, at 3:00 P.M. Local Time at Richmond High School, 380 Hub Etchison Parkway, 47374. Meet at the main entrance lobby. Tours of the building will follow.

3. TIME FOR RECEIVING THE BIDS:

Bids received prior to the time of opening will be securely kept unopened. Bids submitted by mail should be addressed to Richmond Community Schools (hereinafter referred to as the "Owner"), 300 Hub Etchison Parkway, Richmond, Indiana 47374, ATTN: Karen Scalf. The person whose duty it is to open them will decide when the specified time has arrived. Bids received after said time but during bid opening meeting shall be noted with time of receipt, opened, and publicly read aloud, and thereafter handled by the Owner as required by applicable law. No responsibility will be attached to the office for the premature opening of a bid not properly addressed and identified. Telegraphic modification of bids already submitted will not be considered.

4. SUBSTITUTIONS:

Each bidder represents that his bid is based upon the materials and equipment described in the bidding documents.

Whenever a particular brand, product name or named manufacturer is listed in the Contract Documents, the intent is to establish a level of quality, performance or product characteristic and is not intended to limit competition or prevent a Bidder from proposing the use of a different but functionally comparable brand, product or manufacturer. The Bidder is advised to follow the procedures for submittal of such a proposed alternate or substitution that are contained in the immediately following paragraph.

No substitution will be considered unless written request has been submitted to the A/E for approval at least ten (10) days prior to the date for receipt of bids for single items and fourteen (14) days for multiple items. Each such request shall include a complete description of the proposed substitute, the name of the material or equipment for which it is to be substituted, drawings, cuts, performances and test data, written statement to indicate where any differences occur, and any other data or information necessary for complete evaluation. A/E will make no determination unless all of the above information is provided. The A/E is not obligated to contact the provider of such request to gain any of the above information not supplied and furthermore will not act upon any request where all of the above information and data is not supplied with request.

5. VOLUNTARY ALTERNATE BIDS:

Voluntary alternate bids will not be considered unless called for or approved by the A/E.

6. CORRECTIONS:

Erasures or other changes in the bids must be explained or noted over the signature of the bidder.

7. UNIT PRICES:

The Contractor shall submit unit prices for any items requested. These unit prices will be used in determining additions to or deductions from the contract amount, when authorized changes in the Work, as shown on the Drawings and/or Specifications, are directed. Any bidder not complying with this request will put his bid in jeopardy of being accepted.

Unit prices shall include the furnishing of all labor and materials, overhead and profit, complete in place unless otherwise noted.

8. CONTRACTOR'S DIRECT PARTICIPATION IN WORK:

Per Indiana Public Works statute IC 5-16-13-9 the General Contractor will be required to complete at least fifteen (15%) percent of the labor portion of the contract work with his own organization. Acceptable forms of self-performance which may be included in calculating the total cost of labor performed to meet this requirement include the following:

- a. Actual work performed on the project by its own employees.
- b. The costs/value of materials supplied directly by the contractor to the project
- c. The value of services provided directly by the contractor's employees that total at least 15% of the General Contractor's total contract price

All other Contractors and Subcontractors will be required to complete at least fifteen (15%) percent of the labor portion of the Contract Work with his own organization, based on similar calculations to those noted above. This percentage shall be exclusive of the Contractor or Subcontractors' supervision.

9. TAXES, PERMITS, INSPECTIONS, ETC.:

All bid amounts are to include the cost of all state and local taxes, cost of all required permits and inspections as required by governing agencies other than local inspections and permits. This project being a school project, all fees have been waived by the City of Richmond. State sales tax is not to be included in the bid price. The Owner is sales tax exempt. The exemption number shall be furnished by the Owner to the Contractor for his use.

10. PREPARATION AND SUBMISSION OF BIDS:

Proposals shall be submitted on General Form No. 96 (Revised 2010), prescribed by the Indiana State Board of Accounts (Bid Form) and on the Bid Proposal Form provided in this manual, Section 000400.

Sealed Bids and Number Required:

- a. All bids must be submitted in duplicate.
- b. The Bid, bid security, and other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party indicated below and shall be identified with the Project name, division of work and the Bidder's name and address. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.

Karen Scalf
Chief Financial Officer
Richmond Community Schools
Richmond High School Fire Alarm Upgrades
300 Hub Etchison Parkway
Richmond, Indiana 47374

- c. The Owner may consider, as informal, any bid on which there is an alteration of or departure from the bid procedure stated herein.

The bidder is required to submit proposals for all alternates and unit prices. In the event the bidder does not desire to make a change from the base bid, he shall so indicate by using the words "no change".

Indication of Amounts:

- a. Each proposal shall have the amount written with ink or typewritten in words and figures. Should there be any discrepancies between the words and figures indicating any amount in the proposal, the amount written in words shall be taken as the correct amount.
- b. Any bid may be rejected if it contains any alterations or erasures.

Requirements for Signing Bids:

- a. Any bid not signed by the individual marking same shall have attached to it a Power of Attorney evidencing authority to sign the bid in the name of the person for whom it is signed.
- b. A bid signed for a partnership shall be signed by one of the partners, or by an attorney-in-fact. If signed by an attorney-in-fact, there shall be a Power of Attorney attached to the bid evidencing authority to sign the bid, executed by the partners.
- c. Bids which are submitted by a corporation shall have the correct name thereof and the signature of the president or other authorized officer of the corporation and secretary or an

assistant secretary manually written below the corporate name following the word "by _____".

Bid Guarantee:

- a. Each bid must be accompanied by a bid guarantee, which shall be not less than five percent (5%) of the amount of the bid. Bidders may, at their option, submit bid guarantee in the form of a certified check, bank draft, U. S. Government Bond (as par value) or a Bid Bond A.I.A. Form A-310. Certified check or bank draft must be made payable to the order of Richmond Community Schools. Cash deposits will not be accepted. The bid guarantee shall insure the execution of the Contract and the furnishing of Performance & Labor and Material Payment Bonds by the successful bidder, as specified in the Contract Documents.
- b. Contractor is authorized to use the bonding company's standard bid bond, in lieu of the A.I.A. form specified in paragraph above, provided the form is substantially the same.
- c. Revised bids, whether forwarded by mail or telegram, if representing an increase in excess of two percent of the original bid, must have the bid guarantee adjusted accordingly, otherwise, the revision of the bid will not be considered, and the original bid shall remain in force.
- d. In case bid guarantee is in the form of a certified check, bank draft, or U. S. Government Bond, the Owner may make such disposition of the same as will accomplish the purpose for which it was submitted. Certified checks or bank drafts, or the amount thereof, and U. S. Government Bonds of unsuccessful bidders will be returned as soon as practical after the opening of the bids.
- e. Unless otherwise provided in any supplement to these Instructions to Bidders, no bidder shall modify, withdraw or cancel his bid or any part thereof for ninety (90) days after the time designated for the receipt of bids without the consent of the Owner.

Questionnaire:

- a. Each set of bids shall be accompanied by a fully executed copy of General Form No. 96 (Revised 2010) prescribed by the Indiana State Board of Accounts (Standard Questionnaire and Financial Statement for Bidders).

Non-Collusion Affidavit:

- a. Each bidder shall furnish, with his bid, an affidavit that such bidder has not directly or indirectly entered into a combination, undertaking, collusion, or agreement with any other bidder or prospective bidder, or with any officer or member of the Board of Education which tends to or does lessen or destroy free competition in the letting of contracts sought for these Instructions to Bidders.

11. AWARD OF CONTRACT:

When Award is Effectual:

- a. The Contract shall be deemed to have been awarded when notice of award shall have been duly served upon the awardee (i.e., the bidder or bidders to whom the Owner contemplates awarding the Contract or Contracts) by some officer or agent of the Owner duly authorized to give such notice.

Award of Contract, Rejection of Bids:

- a. The Contract will be awarded to the lowest responsible bidder complying with the conditions of the Bidding Documents, provided his bid is reasonable, and it is in the interest of the Owner to accept it. The bidder to whom the award is made will be notified at the earliest possible date. The Owner, however, reserves the right to reject any and all bids, and waive any informality in bids received whenever such rejection or waiver is in the interest of the Owner.

The Owner also reserves the right to reject the bid or any bidder who has previously failed to perform properly or complete on time, Contracts of a similar nature; who is not in a position to perform the Contract; or, who has habitually and without just cause neglected the payment of bills or otherwise disregarded his obligations to subcontractors, material-men or employees.

In determining the lowest responsible bidder, the following elements, in addition to those above mentioned, will be considered:

- a. Whether the bidder involved:
 - 1) maintains a permanent place of business,
 - 2) has adequate plant equipment and personnel to do the work properly and expeditiously,
 - 3) has a suitable financial status to meet the obligations incidental to the work,
 - 4) and has appropriate technical experience.
- b. If required, the bidder shall submit to the A/E, a properly executed Contractor's Qualifications Statement, A.I.A. Document A305.
- c. The Owner reserves the right to accept any, or all, or any combination of the requested alternates, and accept them in any order as he may deem it to be in his best interest in determining the lowest responsible bidder.

Performance Bond, Payment Bond, Execution of Contract:

- a. The successful bidder will be required to furnish to the Owner Performance & Labor and Material Payment Bonds in a penal sum of one hundred percent (100%) of the total amount payable by the terms of the contract.

Bonds shall be executed by a surety company or letter of credit issuer bank, as applicable, in a form approved by the Owner, Contractor and surety or letter of credit issuer bank, as

applicable. Such bond, among other conditions, shall be conditioned for payment for all material used in the work and for all labor performed in the work, whether by subcontractor or otherwise.

- 1) Said bond shall remain in full force and effect, during the life of the contract and during the term of any guarantee or warranty required by the specifications.
- 2) Contractor shall keep his Bonding Company informed of any and all changes in amount of his contract with the Owner.

It is understood and agreed that the Surety expressly waives whatever right it may have to be notified on any alterations, modifications, and additions which may be directed by Owner or A/E under the terms hereof. And it expressly agrees that no change, modifications, omission or addition in and to the terms or conditions of this contract, said plans, specifications, or profiles, or any irregularity or defect in this contract or in the proceedings preliminary to the letting and awarding thereof, shall in no way affect or operate to relieve, release or discharge said Surety.

- b. The successful bidder will be required to execute a contract with the Owner, in the Standard A.I.A. Form A101 (latest edition), in such manner of counterpart as the Owner may request.
- c. Such Performance & Labor and Material Payment Bonds will be furnished, and such Contract shall be executed and delivered, by the successful bidder within ten days after notice of award of contract by the Owner.

Liquidated Damages for Failure to Enter Into Contract:

- a. The successful bidder, upon his failure or refusal to execute and deliver the Contract and bond required within ten (10) days after he has received notice of the award of work, shall forfeit to the Owner as liquidated damage for such failure or refusal, the security deposited with his bid.

12. NONDISCRIMINATION PROVISIONS

- a. General:

The Contractor shall perform, observe and comply with all applicable state, municipal and federal laws, rules, regulations and Executive Orders pertaining to nondiscrimination against employees or applicants for employment because of race, color, religion, national origin or ancestry. When required by such laws, rules, regulations and Executive Orders, the Contractor shall include nondiscrimination provisions in all contracts and purchase orders.

- b. State of Indiana Requirements:

Pursuant to Indiana Code 22-9-1-10 and the Civil Rights Act of 1964, the parties and any contractors or subcontractors thereof, shall not discriminate against any employee or applicant for employment in the performance of this contract. Parties shall not discriminate with respect to the hire, tenure, terms conditions or privileges

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of employment or any matter directly or indirectly related to employment, because of race, color, religion, sex, disability, national origin or ancestry. Breach of this provision may be regarded as a material breach of this contract.

13. INDIANA PUBLIC WORKS LAW CERTIFICATE

Contractor will be expected to execute the following Public Works Law Certificate.

INDIANA PUBLIC WORKS LAW CERTIFICATION

_____ (Name), _____ (Position) at _____
(Entity) ("Company"), hereby certify that:

1. I have personal knowledge of the facts recited herein. I am over the age of eighteen (18) and am mentally competent to make this certification.+
2. As a _____ (Position) at Company, I am competent, authorized, and capable to execute this certification on Company's behalf.
3. This certification is made pursuant to Ind. Code § 5-16-13. I understand the terms and conditions of Ind. Code Sec. 5-16-13 are expressly incorporated by reference into the Contract for the work at _____ ("Project").
4. Company shall maintain general liability insurance in at least the following amounts:
 - 1) for each occurrence limit, One Million Dollars (\$1,000,000.00) and 2) for the general aggregate limit, Two Million Dollars (\$2,000,000.00).
5. Company must be qualified under either Ind. Code § 4-13.6-4 or Ind. Code § 8-23-10.
6. Company must comply with the City and State's E-Verify requirements and submit the _____'s E-Verify affidavit.
7. Company and all of its subcontractors will not pay cash to any individual employed by Company for any work that may be done by the individual on the Project.
8. Company and all of its subcontractors pays all of their employees, including any employees that may work on Project, in accordance with the Fair Labor Standards Act, Title 29, United States Code, Chapter 8. Company and its subcontractors

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have not been found responsible for any violation of the Fair Labor Standards Act or the Indiana Minimum Wage Law in the past three (3) years.

9. Company and all of its subcontractors pay all of their employees, including any employees that may work on Project, in accordance with the minimum wage provisions found in the Indiana Minimum Wage Law, Ind. Code §§ 22-2-2-1 through 22-2-2-8.
10. Company and all of its subcontractors are in compliance with the Indiana Workers Compensation requirements contained in Ind. Code §§ 22-3-5-1 and 22-3-7-34.
11. Company and all of its subcontractors are in compliance with Indiana Unemployment Compensation requirements contained in Ind. Code §§ 22-4-1 through 22-4-39.5.
12. Company and all of its subcontractors must be in compliance with Indiana's Drug Testing requirements for employees in Ind. Code §§ 4-13-18-1 through 4-13-18-7.
13. Company must comply with the training requirements provided Ind. Code § 5-16-13- 12.
14. Company certifies that it shall self-perform at least 15% of the total Project.
15. Company shall preserve payroll and related records for a period of three (3) years after the completion of the project work and open them to inspection by the Department of Workforce Development.
16. During the term of this Agreement, Company shall enroll in and verify the work eligibility status of all newly hired employees of the company through the E-Verify program of the federal government if, and only if, such E-Verify program continues to exist.

I affirm under penalties for perjury that Company does not knowingly hire an illegal alien.

17. I further affirm under penalties for perjury that neither the Company nor any principals of or employees of the Company engage in investment activities with the nation state of

Iran, as said activities are defined at IC 5-22-16.5-8.

Signature

END OF SECTION 000100

FORM OF PROPOSAL

For: **RICHMOND COMMUNITY SCHOOLS**
RICHMOND HIGH SCHOOL MECHANICAL MODERNIZATION

LWC Incorporated
712 East Main Street
Richmond, IN 47374
Tel: 765-966-3546
Fax: 765-962-9195

SUBMITTED BY:

Name: _____
Address: _____

Telephone: _____
Fax: _____
Email: _____

TO: Richmond Community Schools
300 Hub Etchison Parkway
Richmond, IN 47374

Checklist:

- | | |
|--|---|
| <input type="checkbox"/> State Form 96 (Revised 2013) | <input type="checkbox"/> Financial Statement |
| <input type="checkbox"/> Bid Bond | <input type="checkbox"/> Indiana Public Law Certificate |

Bonding Co.: _____

Addenda Received: _____

The undersigned, having carefully examined all contract documents, including Instructions to Bidders, General Conditions, Modifications to General Conditions, Special Conditions, Drawings, and Specifications and Addenda entitled:

Richmond Community Schools
Richmond High School Mechanical Modernization

Dated August 28, 2021, prepared by LWC Incorporated (Architects), Richmond, Indiana, and having examined the site, hereby proposed to furnish all materials, all services, all labor, and all equipment to complete all work as described in the contract documents for the following:

BASE BID:

TOTAL BASE BID – SINGLE PRIME CONTRACT:

\$ _____

SUM IN WORDS: _____

ALLOWANCES

The following allowances are included in the Base Bid:

NONE.

UNIT PRICES

Unit Price No. 1 – Replace existing Smoke Detector:

_____ Dollars Per Unit

(\$ _____) Per Unit

ALTERNATES:

ALTERNATE NO. 1 – Additional Scope at Existing South Chiller Location:

ALL LABOR AND MATERIALS, for the sum of **ADD \$** _____

Sum in words: _____

ALTERNATE NO. 2 – Additional Classroom Finishes:

ALL LABOR AND MATERIALS, for the sum of **ADD \$** _____

Sum in words: _____

ALTERNATE NO. 3 – Additional Mechanical Scope at Unit C:

ALL LABOR AND MATERIALS, for the sum of **ADD \$** _____

Sum in words: _____

ALTERNATE NO. 4 – New Equipment in Fan Room L103 at Unit C:

ALL LABOR AND MATERIALS, for the sum of **ADD \$** _____

Sum in words: _____

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ALTERNATE NO. 5 – Extend Ceiling and lighting replacement in hall around pool:

ALL LABOR AND MATERIALS, for the sum of **ADD \$** _____

Sum in words: _____

ALTERNATE NO. 6 – Alternate Controls Contractor:

ALL LABOR AND MATERIALS, for the sum of **ADD \$** _____

Sum in words: _____

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SIGNATURE SHEET:

A CORPORATION: _____

STATE IN WHICH INCORPORATED: _____

A PARTNERSHIP: _____

AN INDIVIDUAL: _____

BY: _____
Signature Title

BY: _____
Signature Title

BUSINESS ADDRESS:

DATE: _____

NOTE: A CORPORATION must present a certified copy of a resolution by its Board of Directors authorizing the signing of this proposal by any person other than the President of the Corporation. AN INDIVIDUAL must be the Owner and state the name of his business, as well as his full legal name.

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VOLUNTARY ALTERNATES:

Contractors may voluntarily propose additional Alternates for the Owner's consideration.

Bidders desiring to submit voluntary Alternates shall list each below, together with the amount to be added to, or deducted from, the amount of their base bid. A brief description of each Alternate shall be included.

| Voluntary Alternate # | Proposed Alternate | Add | Deduct |
|-----------------------|--------------------|-----|--------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

SUBSTITUTION SHEET:

All bids shall be based upon the "Standards" specified. (See standard substitution provision of specifications.)

Bidders desiring to make substitutions for "Standards" specified, shall list each proposed substitution below, together with the amount to be added to, or deducted from, the amount of their base bid.

| Brand or Make Specified | Proposed Substitution | Add | Deduct |
|-------------------------|-----------------------|-----|--------|
| | | | |
| | | | |
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| | | | |
| | | | |

END OF FORM OF PROPOSAL



CONTRACTOR'S BID FOR PUBLIC WORK - FORM 96

State Form 52414 (R2 / 2-13) / Form 96 (Revised 2013)

Prescribed by State Board of Accounts

PART I

(To be completed for all bids. Please type or print)

Date (month, day, year): _____

1. Governmental Unit (Owner): _____

2. County : _____

3. Bidder (Firm): _____

Address: _____

City/State/ZIPcode: _____

4. Telephone Number: _____

5. Agent of Bidder (if applicable): _____

Pursuant to notices given, the undersigned offers to furnish labor and/or material necessary to complete the public works project of _____

(Governmental Unit) in accordance with plans and specifications prepared by _____

_____ and dated _____ for the sum of

_____ \$ _____

The undersigned further agrees to furnish a bond or certified check with this bid for an amount specified in the notice of the letting. If alternative bids apply, the undersigned submits a proposal for each in accordance with the notice. Any addendums attached will be specifically referenced at the applicable page.

If additional units of material included in the contract are needed, the cost of units must be the same as that shown in the original contract if accepted by the governmental unit. If the bid is to be awarded on a unit basis, the itemization of the units shall be shown on a separate attachment.

The contractor and his subcontractors, if any, shall not discriminate against or intimidate any employee, or applicant for employment, to be employed in the performance of this contract, with respect to any matter directly or indirectly related to employment because of race, religion, color, sex, national origin or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

CERTIFICATION OF USE OF UNITED STATES STEEL PRODUCTS

(If applicable)

I, the undersigned bidder or agent as a contractor on a public works project, understand my statutory obligation to use steel products made in the United States (I.C. 5-16-8-2). I hereby certify that I and all subcontractors employed by me for this project will use U.S. steel products on this project if awarded. I understand that violations hereunder may result in forfeiture of contractual payments.

ACCEPTANCE

The above bid is accepted this _____ day of _____, _____, subject to the following conditions: _____

Contracting Authority Members:

| | |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

PART II

(For projects of \$150,000 or more – IC 36-1-12-4)

Governmental Unit: _____

Bidder (Firm) _____

Date (month, day, year): _____

These statements to be submitted under oath by each bidder with and as a part of his bid. Attach additional pages for each section as needed.

SECTION I EXPERIENCE QUESTIONNAIRE

- 1. What public works projects has your organization completed for the period of one (1) year prior to the date of the current bid?

| Contract Amount | Class of Work | Completion Date | Name and Address of Owner |
|-----------------|---------------|-----------------|---------------------------|
| | | | |
| | | | |
| | | | |
| | | | |

- 2. What public works projects are now in process of construction by your organization?

| Contract Amount | Class of Work | Expected Completion Date | Name and Address of Owner |
|-----------------|---------------|--------------------------|---------------------------|
| | | | |
| | | | |
| | | | |
| | | | |

3. Have you ever failed to complete any work awarded to you? _____ If so, where and why?

4. List references from private firms for which you have performed work.

SECTION II PLAN AND EQUIPMENT QUESTIONNAIRE

1. Explain your plan or layout for performing proposed work. *(Examples could include a narrative of when you could begin work, complete the project, number of workers, etc. and any other information which you believe would enable the governmental unit to consider your bid.)*

2. Please list the names and addresses of all subcontractors *(i.e. persons or firms outside your own firm who have performed part of the work)* that you have used on public works projects during the past five (5) years along with a brief description of the work done by each subcontractor.

3. If you intend to sublet any portion of the work, state the name and address of each subcontractor, equipment to be used by the subcontractor, and whether you will require a bond. However, if you are unable to currently provide a listing, please understand a listing must be provided prior to contract approval. Until the completion of the proposed project, you are under a continuing obligation to immediately notify the governmental unit in the event that you subsequently determine that you will use a subcontractor on the proposed project.

4. What equipment do you have available to use for the proposed project? Any equipment to be used by subcontractors may also be required to be listed by the governmental unit.

5. Have you entered into contracts or received offers for all materials which substantiate the prices used in preparing your proposal? If not, please explain the rationale used which would corroborate the prices listed.

SECTION III CONTRACTOR'S FINANCIAL STATEMENT

Attachment of bidder's financial statement is mandatory. Any bid submitted without said financial statement as required by statute shall thereby be rendered invalid. The financial statement provided hereunder to the governing body awarding the contract must be specific enough in detail so that said governing body can make a proper determination of the bidder's capability for completing the project if awarded.

BID OF

(Contractor)

(Address)

FOR
PUBLIC WORKS PROJECTS
OF

Filed _____

Action taken _____

SECTION 000500 – PRELIMINARY SCHEDULE

1.1 PROJECT SCHEDULE

- A. First Advertisement: August 27, 2021
- B. Second Advertisement: September 03, 2021
- C. Pre-bid Meeting: September 07, 2021, at 3:00 pm.
- D. Last Day for Bidder Questions: September 17, 2021
- E. Date of Last Addendum: September 21, 2021
- F. Bids Due: September 24, 2021, at 3:00 pm.
- G. Anticipated Contract Award: October 06, 2021
- H. Issue Notice to Proceed: October 07, 2021
- I. Construction Start: November 01, 2021* (Refer to Phasing Plans)
 - Phase 1: Chiller Work (Start November 01, 2021)
 - Phase 2: Boiler Work ** (Start approx. April, 2022 – Coordinate w/ end of heating)
 - Phase 3: Natatorium & Library Work** (Start contingent on Phase 2)
- C. Substantial Completion Date: July 22, 2022**
- D. Punchlist Completed: August 05, 2022

* Note: Work in Central Plant (a.k.a. Boilerhouse) may be performed during school hours. All work inside the building during the regular school year, including work in the tunnels and basement, must be performed off hours when students are not in the building (from after 4:00 pm to 7:00 am). Work during summer school (June 06, 2022 – August 05, 2022) may be performed inside the building, including work in the tunnels and basements, at any time.

**Note: It is anticipated that after hours work will be required to meet the project schedule. The Contractor shall be responsible for any after hours or premium costs required to meet the Date of Substantial Completion.



AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Richmond Community Schools
Richmond High School
Mechanical Modernization Project

THE OWNER:

(Name, legal status and address)

Richmond Community Schools
Board of Trustees
300 Hub Etchison Parkway
Richmond, IN 47374

THE ARCHITECT:

(Name, legal status and address)

LWC Incorporated
712 East Main Street
Richmond, IN 47374

TABLE OF ARTICLES

- 1 GENERAL PROVISIONS
- 2 OWNER
- 3 CONTRACTOR
- 4 ARCHITECT
- 5 SUBCONTRACTORS
- 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
- 7 CHANGES IN THE WORK
- 8 TIME
- 9 PAYMENTS AND COMPLETION
- 10 PROTECTION OF PERSONS AND PROPERTY
- 11 INSURANCE AND BONDS
- 12 UNCOVERING AND CORRECTION OF WORK
- 13 MISCELLANEOUS PROVISIONS

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

Init.

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES



Init.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent

consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™-2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements,

assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the

Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the

Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations

and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor,

prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work,

promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will

affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and

unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 **Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 **Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 **Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to

the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance,

the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the

Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator’s fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.



Init.
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SECTION 000800 - SUPPLEMENTARY CONDITIONS

The following Supplementary Conditions modify, change, delete or add to the General Conditions of the contract for Construction.

1. INDIANA SALES AND USE TAX:

The labor and materials furnished under this contract will be used, when the project is completed by the Owner for its tax exempt purposes. Accordingly, the Indiana Gross Retail and Use Tax (Sales and Use Tax) will not apply to the purchase of materials under this contract by the Owner from the Contractor. The Owner will issue an appropriate exemption certificate to the Contractor to that effect.

2. SPECIAL PROVISIONS REGARDING RETAINAGE, BONDS AND PAYMENT OF CONTRACTORS AND SUB-CONTRACTORS:

Effective May 1, 1972, the laws of the State of Indiana (IC 1971 5-16-5.5) contain certain special provisions regarding retainage, bonds and payment of contractors and sub-contractors. The contracts entered into will be governed by those provisions. With respect to contracts in excess of \$200,000 entered into between a contractor and the Owner, these provisions require among other things, that the amounts retained by the Owner from the contractor pursuant to retainage provisions be placed in an escrow account in accordance with a written escrow agreement to be executed by the contractor. Pursuant to these provisions, the successful bidder will be required to comply with all applicable provisions of the statute referred to above with respect to each of his sub-contractors (as the term sub-contractor is defined in the statute referred to above). The form of the escrow agreement shall be in accordance with the agreement bound hereafter.

3. PAYMENTS TO CONTRACTORS:

Monthly payments will be based on 90% of the value of the labor performed and materials incorporated into the building project since the preceding payment period, plus 90% of the value of the materials suitably stored and protected at the site ready for incorporation in the work. Applications for payment, subsequent to the first application, shall be accompanied by Affidavits and Waivers of Lien from the prime contractors and all major suppliers/subcontractors.

Form of application for payment shall be AIA Document G-702, Application and Certificate for Payment, supported by AIA Document G703, Continuation Sheet, executed in same form as the Schedule of Values. Application shall be submitted in quintuplet including all supporting documentation.

All contracts above two hundred thousand dollars (\$200,000) must provide for a retainage to be withheld from progress payments made by the Owner to the Contractor. At the election of the Contractor, the funds comprising the retainage shall be placed in an escrow account with a bank or savings and loan association mutually agreeable to the Contractor and Owner and authorized

by a written agreement executed by each. If the Contractor agrees, the funds comprising the retainage may be held by the Owner pending final payment, as defined in the Contract Documents. In such a case, the retainage funds held by the Owner shall not bear interest during the term of the escrow. The retainage to be withheld can be either:

1. Ten percent (10%) of the dollar value of all satisfactory work completed up to fifty percent (50%) complete or
2. Five percent (5%) of the dollar value until all work is completed.

Within sixty-one (61) days following the date of substantial completion, the contractor shall be paid all escrow principal and income. However, if any work remains, two hundred percent (200%) of the value of each item value shall be retained.

Bills of sale, vouchers or such other evidence to support the contractor's right to payment for the latter condition may be required for the Owner's protection. No material thus paid for to be removed from the premises without the Owner's permission.

Contractor shall furnish, before the first application, a schedule of values of the various parts of the work aggregating the total sum of the contract. This schedule when approved by the A/E, shall be used as a basis for certificate of payment. In applying for payments, the contractor shall submit a statement based on this application, showing his right to the payment claimed. Application shall be made ten (10) days before payment is due.

Final payment due and payable sixty-one (61) days following final completion and acceptance of work.

Final application for payment shall be accompanied by the following additional documents: AIA Document G706, Contractor's Affidavit of Payment of Debts and Claims; AIA Document G706A, Contractor's Affidavit of Release of Liens; AIA Document G707, Consent of Surety, Unconditional Final Waivers of Lien from all Sub-contractors and Suppliers and Final Conditional Waivers of Lien from the Prime Contractors.

4. INSURANCE REQUIREMENTS:

Add the following to Subparagraph 11.2.1 of AIA Document A201-2017, General Conditions of the Contract for Construction.

OWNER'S LIABILITY INSURANCE:

The Owner shall be responsible for and at his option may maintain such insurance as will protect from his contingent liability to others for damages because of bodily injury, including death, which may arise from operations under the Contract, and any other liability for damages which the Contractor is required to insure under any provision of the Contract.

CONTRACTOR'S LIABILITY INSURANCE:

RICHMOND COMMUNITY SCHOOLS
RICHMOND HIGH SCHOOL
MECHANICAL MODERNIZATION PROJECT
LWC COMMISSION NO. 20104.02

- A. Each Contractor shall take out and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the work is located, insurance of such types and in such amounts as are necessary to protect the Contractor from claims set forth below which may arise of or result from the Contractor's operations under the Contract and for which the Contractor may be legally liable whether such operations be by the Contractor or by a subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable.
- B. No Contractor shall commence work under this contract until he has obtained all insurance required under this Section and such insurance has been approved by the Owner, nor shall any Contractor allow any subcontractor to commence work on his subcontract until the required insurance has been obtained by the subcontractor and approved by the Owner. Each and every Contractor and Subcontractor shall maintain all insurance required under paragraph E of this Section for not less than one year after completion of this contract.
- C. Contractor shall submit to the Architect four (4) copies of Certificates of Insurance for this review and the Owner's approval prior to commencement of the Work. The form of certificate preferred is AIA Document G705, Certificate of Insurance. Certificates shall include each and every type of coverage specified.

In the event the Contractor engages Subcontractor for all or a portion of the work required by this agreement, the Contractor will require any and all Subcontractors to also assume all of the duties, obligations and requirements in this Section. The Contractor shall require each Subcontractor to provide Certificates of Insurance evidencing the insurance required by this Section naming the Contractor and Owner (and Building Corporation if bid is assigned by Owner to Building Corporation) as Additional Insureds, except as respects Workers' Compensation Insurance and that insurance carried and maintained by the Subcontractor meets all the requirements of this Section.

- D. If requested by the Owner, Contractor shall furnish the Owner with true copies of each policy required of him or his subcontractors. Said policies will not be cancelled or materially altered, except after thirty (30) days advance written notice to the Owner and Architect, mailed to the addresses indicated herein.
- E. Liability insurance shall include all major divisions of coverage and be on a comprehensive basis including:
1. Premises' Operations (deleting any X-C or U exclusions).
 2. Products and Completed Operations.
 3. Contractual, including specific provisions for the Contractor's obligations under Paragraph I.
 4. Owned, Non-Owned, and Hired motor vehicles.
 5. Broad Form Property Damage including Completed Operations.

Except with respect to bodily injury and property damage included within the products and completed operations hazards, the aggregate limit where applicable shall apply separately to each project under this Contract.

Coverage shall be written on an "Occurrence" form unless otherwise approved by the Owner.

The Architect and the Owner (and Building Corporation if bid is assigned by Owner to Building Corporation) shall be named as additional Insureds under the Comprehensive General Liability Insurance policy or the Commercial General Liability Policy.

- F. The insurance required by Paragraph E above shall be written for not less than any limits of liability shown on the "Schedule of Insurance Coverages Required" found herein, or required by law, whichever is greater.

SCHEDULE OF INSURANCE COVERAGES REQUIRED

| <u>TYPE OF INSURANCE</u> | | <u>LIMITS OF LIABILITY</u> | |
|---|--|--|--|
| | | <u>EACH OCCURRENCE AGGREGATE</u> | |
| 1. a) Workers' Compensation b) Employer's Liability | Statutory | \$ 1,000,000/\$500,000/\$100,000 | |
| 2. Comprehensive General Liability Including: (X) Premises/Operations (X) Underground Explosion & Collapse Hazard (X) Products/Completed Opr. (X) Contractual Liability (X) Independent Contractors (X) Broad Form Prop. Damage (X) Personal Injury (X) <u>Aggregate by Job Site</u> Endorsement | BODILY INJURY PROPERTY DAMAGE BI & PD COMBINED PERSONAL INJURY | \$ 1,000,000 \$ 1,000,000 \$ 1,000,000 | \$ 2,000,000 \$ 2,000,000 \$ 2,000,000 \$ 2,000,000 |
| 3. Comprehensive Automobile Liability (X) Any Auto (X) All Owned Autos (X) Hired Autos (X) Non-Owned Autos () _____ | BODILY INJURY (PER PERSON) BODILY INJURY (PER ACCIDENT) PROPERTY DAMAGE BI & PD | \$ 1,000,000 \$ 1,000,000 \$ 1,000,000 \$ 1,000,000 | \$ 1,000,000 |
| 4. Excess Liability | | | |

| | | | |
|---------------------------------|----------|--------------|--------------|
| (X) Umbrella Form | BI & PD | \$ 5,000,000 | \$ 5,000,000 |
| () Other Than Umbrella Form | COMBINED | | |

5. Other (Specify)

H. If the Contractor's General Liability Insurance is provided by the Commercial Liability form (Occurrence Form), the Contractor's Automobile Liability Insurance shall include coverage for "Automobile Contractual Liability."

I. Hold Harmless Agreement

1. The Contractor shall indemnify and hold harmless the Owner and the Architect and their agents and employees from and against all claims, damages, losses and expenses including attorney's fee arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (including but not limited to the work) including the loss of use resulting therefrom, and (b) is caused in whole or in part by any negligent act or omission of the Contractor, any subcontractor, any one directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.
2. In any and all claims against the Owner or the Architect or any of their agents or employees by an employee of the Contractor, Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Hold Harmless Agreement shall not be limited in any way by any limitation on the amount payable by or for the Contractor or any Subcontractor under workmen's compensation acts, disability benefit acts or other employee benefits acts.
3. The obligations of the Contractor under this Hold Harmless Agreement shall not extend to any claim, damage, loss or expense for which the Architect is legally liable arising out of professional services performed by the Architect, his agents, or employees, including (1) the preparation of maps, plans, opinions, reports, surveys, designs or specifications, and (b) periodic observation of the work or engineering services.

PROPERTY INSURANCE

- A. The Contractor shall provide insurance coverage for portions of the Work stored off the site after written approval of the Owner at the value established in the approval, and also for portions of the work in transit.

- B. Each Contractor shall make such provisions as he deems necessary to replace all items of his work missing by theft prior to acceptance of his work by the Owner.

5. NONDISCRIMINATION PROVISIONS:

a. General:

The Contractor shall perform, observe and comply with all applicable state, municipal and federal laws, rules, regulations and Executive Orders pertaining to nondiscrimination against employees or applicants for employment because of race, color, religion, national origin or ancestry. When required by such laws, rules, regulations and Executive Orders, the Contractor shall include nondiscrimination provisions in all contracts and purchase orders.

b. State of Indiana Requirements:

Pursuant to Indiana Code 22-9-1-10 and the Civil Rights Act of 1964, the parties and any contractors or subcontractors thereof, shall not discriminate against any employee or applicant for employment in the performance of this contract. Parties shall not discriminate with respect to the hire, tenure, terms conditions or privileges of employment or any matter directly or indirectly related to employment, because of race, color, religion, sex, disability, national origin or ancestry. Breach of this provision may be regarded as a material breach of this contract.

6. ARBITRATION:

The Owner omits Arbitration - Article 15.4 paragraphs 15.4.1 thru 15.4.3 which is a part of AIA Document A201-2017, General Conditions of the Contract for Construction.

7. CHANGES IN THE WORK:

1. Add the following to subparagraph 7.2.2:

In subparagraph 7.2.2 the allowance for overhead and profit combined, included in the total cost to the Owner, shall be based on the following schedule:

- a. For the contractor, for the work performed by the contractor's own forces, fifteen percent (15%) of the cost.
- b. For the contractor, for work performed by his subcontractor, five percent (5%) of the amount due the subcontractor.
- c. For each subcontractor or sub-subcontractor involved, for work performed by his own forces, fifteen percent (15%) of the cost.
- d. For each subcontractor, for work performed by his sub-subcontractor, for work

performed by his sub-subcontractors, five percent (5%) of the amount due the sub-subcontractors.

- e. Cost to which overhead and profit is to be applied shall be determined in accordance with Section 012100 -Allowances.
- f. In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and subcontractors. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are subcontracts, they shall be itemized also. In no case will a change involving over \$500.00 be approved without such itemization.

8. GUARANTEE:

Contractor shall guarantee in writing for a period of one year from the date of final acceptance of the work against any and all defects in materials and/or workmanship that should manifest themselves within that period. Installations that are defective shall be removed and replaced without expense to the owner and to his satisfaction.

9. PERMITS:

Refer to INSTRUCTIONS TO BIDDERS - #9 TAXES, PERMITS, INSPECTIONS, ETC.

10. SCHEDULE OF WORK:

Progress and Completion:

Add the following subparagraphs to paragraph 8.2.4 and 8.2.5:

"8.2.4 Each prime contractor, subcontractor, and/or material company shall furnish sufficient labor forces, construction plant and equipment, temporary heat, enclosures, etc., required for their work and protection unless specified elsewhere, and shall work such hours, including night shifts and overtime operations as may be necessary to insure the prosecution of the work in accordance with the approved current progress schedule. If, in the opinion of the Architect or General Contractor, the Contractor falls behind the progress schedule, the Contractor shall take such steps as may be necessary to improve his progress and the Architect or General Contractor may require him to increase the number of shifts, and/or overtime operations, days of work, and/or the amount of construction plant, all without additional cost to the Owner. Failure of the Contractor to comply with the requirements of the Architect or General Contractor under this provision shall be grounds for determination by the Architect that the Contractor is not prosecuting the work with such diligence as will insure completion within the time specified. Upon such determination, the Owner shall have the right, without limiting any other right he may have to either not approve reduction of retainage or to terminate the Contractor's right to proceed with the work or any separable part thereof."

"8.2.5 Timely performance is an expressed condition of the contract and any delay in the

Contractor's performance may excuse the Owner from his obligation to perform. Failure to abide by the time condition may be treated as a breach of contract.

11. LIQUIDATED DAMAGES:

- a. If the Contractor fails to achieve Substantial Completion within the associated Contract Time, it would be difficult, if not impossible, to determine the Owner's resulting damage. Therefore, if the Contractor fails to achieve Substantial Completion within the associated Contract Time, the Contractor shall (at the Owner's option) pay to or credit the Owner the Liquidated Damages per day sum of \$3,000 for each day the Contractor Fails to achieve Substantial Completion within the associated Contract Time.
- b. The Liquidated Damages described in this Section 11.a are only intended to compensate the Owner for the direct damages it incurs as a result of the Contractor's failure to achieve Substantial Completion within their associated Contract Times.
- c. The Liquidated Damages described in this Section 11.a are not intended to compensate the Owner for any damages the Owner incurs on account of (1) any claims attributable to the Contractor that are brought by others including Separate Consultants and Separate Contractors or (2) any failure of the Contractor to timely, properly, and completely perform the Contract other than the failure to achieve Substantial Completion within their associated Contract Time.
- d. The parties acknowledge that the above-listed Liquidated Damages per day sum are not penalties, and they each irrevocably waive the right (if any) to challenge the validity and enforceability of those Liquidated Damages per day sums. Notwithstanding other provisions of the Contract Documents to the contrary, if a court determines that the Liquidated Damages per day sum or their applications are void and unenforceable, the Owner shall be entitled to recover the actual damages that it incurs on account of the Contractor's failure to achieve Substantial Completion within the Contract Time.
- e. In addition to other rights that the Owner may have relative to Liquidated Damages, the Contracting Authority may deduct the Liquidated Damages from the Contract Sum as the damages accrue. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall immediately pay the amount of the insufficiency to the Owner.

12. ASBESTOS:

Contractors shall not use any asbestos containing materials for this project. At the end of the project, submit a certification to the A/E and Owner that no asbestos containing materials were used.

13. TOBACCO AND ALCOHOL:

Richmond Community Schools has a strict policy prohibiting the use of tobacco of any kind or alcohol on school property. This policy extends to all construction personnel. Individuals who violate this policy will be asked to leave the jobsite.

14. SEXUAL PREDATOR:

The Contractor shall not permit the employment of anyone who has been convicted of a sex offense requiring the person to register as a sex offender under Indiana Code 35-42-4-11.

15. CRIMINAL HISTORY BACKGROUND CHECKS:

Criminal history background checks shall be procured through Safe Hiring Solutions, LLC and furnished to the Owner, prior to a person being permitted to enter upon the school property for any purpose associated with this Contract. Costs for criminal history background checks shall be borne by any and all prime contractors, sub-contractors, sub-sub-contractors and so on down the line for all tiers of construction personnel who may be or have reason to be on the project site at any time. Contact information: Safe Hiring Solutions, LLC; 10 West Main Street, Danville, Indiana 46122; (317) 745-6946 or (888) 215-8296.

END OF SECTION 000800



AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the day of in the year
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

Richmond Community Schools
Board of Trustees
300 Hub Etchison Parkway
Richmond, IN 47374

and the Contractor:
(Name, legal status, address and other information)

for the following Project:
(Name, location and detailed description)

Richmond Community Schools
Richmond High School
Mechanical Modernization Project

The Architect:
(Name, legal status, address and other information)

LWC Incorporated
712 East Main Street
Richmond, IN 47374

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

Init.

TABLE OF ARTICLES

- 1 THE CONTRACT DOCUMENTS
- 2 THE WORK OF THIS CONTRACT
- 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
- 4 CONTRACT SUM
- 5 PAYMENTS
- 6 DISPUTE RESOLUTION
- 7 TERMINATION OR SUSPENSION
- 8 MISCELLANEOUS PROVISIONS
- 9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

(Check one of the following boxes.)

- The date of this Agreement.
- A date set forth in a notice to proceed issued by the Owner.
- Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

(Check one of the following boxes and complete the necessary information.)

Init.

[] Not later than () calendar days from the date of commencement of the Work.

[] By the following date:

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

| Portion of Work | Substantial Completion Date |
|-----------------|-----------------------------|
|-----------------|-----------------------------|

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be t (\$), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

| Item | Price |
|------|-------|
|------|-------|

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement. (Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

| Item | Price | Conditions for Acceptance |
|------|-------|---------------------------|
|------|-------|---------------------------|

§ 4.3 Allowances, if any, included in the Contract Sum: (Identify each allowance.)

| Item | Price |
|------|-------|
|------|-------|

§ 4.4 Unit prices, if any:

(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

| Item | Units and Limitations | Price per Unit (\$0.00) |
|------|-----------------------|-------------------------|
|------|-----------------------|-------------------------|

§ 4.5 Liquidated damages, if any:

(Insert terms and conditions for liquidated damages, if any.)

§ 4.6 Other:

Init.

(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the day of the month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than () days after the Architect receives the Application for Payment. *(Federal, state or local laws may require payment within a certain period of time.)*

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

Init.

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

The first monthly payment will be based on 90% of the value of the labor performed and materials incorporated into the building project since the preceding payment period, plus 90% of the value of the materials suitably stored and protected at the site ready for incorporation in the work. Applications for payment, subsequent to the first application, shall be accompanied by Affidavits and Waivers of Lien from the prime contractors and all major suppliers/subcontractors.

Form of application for payment shall be AIA Document G-702, Application and Certificate for Payment, supported by AIA Document G703, Continuation Sheet, executed in same form as the Schedule of Values. Application shall be submitted in quintuplet including all supporting documentation.

All contracts above two hundred thousand dollars (\$200,000) must provide for a retainage to be withheld from progress payments made by the Owner to the Contractor. At the election of the Contractor, the funds comprising the retainage shall be placed in an escrow account with a bank or savings and loan association mutually agreeable to the Contractor and Owner and authorized by a written agreement executed by each. If the Contractor agrees, the funds comprising the retainage may be held by the Owner pending final payment, as defined in the Contract Documents. In such a case, the retainage funds held by the Owner shall not bear interest during the term of the escrow. The retainage to be withheld shall be:

Ten percent (10%) of the dollar value of all satisfactory work completed up to fifty percent (50%) complete.

Within sixty-one (61) days following the date of substantial completion, the contractor shall be paid all escrow principal and income. However, if any work remains, two hundred percent (200%) of the value of each item value shall be retained.

Bills of sale, vouchers or such other evidence to support the contractor's right to payment for the latter condition may be required for the Owner's protection. No material thus paid for to be removed from the premises without the Owner's permission.

Contractor shall furnish, before the first application, a schedule of values of the various parts of the work aggregating the total sum of the contract. This schedule when approved by the A/E, shall be used as a basis for certificate of payment. In applying for payments, the contractor shall submit a statement based on this application, showing his right to the payment claimed. Application shall be made ten (10) days before payment is due.

Final payment due and payable sixty-one (61) days following final completion and acceptance of work.

Final application for payment shall be accompanied by the following additional documents: AIA Document G706, Contractor's Affidavit of Payment of Debts and Claims; AIA Document G706A, Contractor's Affidavit of Release of Liens; AIA Document G707, Consent of Surety, Unconditional Final Waivers of Lien from all Sub-contractors and Suppliers and Final Conditional Waivers of Lien from the Prime Contractors.

§ 5.1.7.1.1 The following items are not subject to retainage:

(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:

(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:

(Insert any other conditions for release of retainage upon Substantial Completion.)

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner’s prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor’s responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner’s final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect’s final Certificate for Payment, or as follows:

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

(Paragraph deleted)

Litigation in a court of competent jurisdiction

[] Other (*Specify*)

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner’s convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner’s convenience.)

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner’s representative:

(Name, address, email address, and other information)

§ 8.3 The Contractor’s representative:

(Name, address, email address, and other information)

§ 8.4 Neither the Owner’s nor the Contractor’s representative shall be changed without ten days’ prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

Init.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction

(Paragraphs deleted)

- .4 Drawings

| Number | Title | Date |
|--------|-------|------|
|--------|-------|------|

- .5 Specifications

| Section | Title | Date | Pages |
|---------|-------|------|-------|
|---------|-------|------|-------|

- .6 Addenda, if any:

| Number | Date | Pages |
|--------|------|-------|
|--------|------|-------|

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

- .7 Other Exhibits:

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

The Sustainability Plan:

| Title | Date | Pages |
|-------|------|-------|
|-------|------|-------|

[] Supplementary and other Conditions of the Contract:

| Document | Title | Date | Pages |
|----------|-------|------|-------|
|----------|-------|------|-------|

.8 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

This Agreement entered into as of the day and year first written above.

OWNER (Signature)

(Printed name and title)

OWNER (Signature)

(Printed name and title)

CONTRACTOR (Signature)

(Printed name and title)



AIA® Document A101® – 2017 Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the day of in the year
(In words, indicate day, month and year.)

for the following **PROJECT:**
(Name and location or address)

Richmond Community Schools
Richmond High School
Mechanical Modernization Project

THE OWNER:
(Name, legal status and address)

Richmond Community Schools
Board of Trustees
300 Hub Etchison Parkway
Richmond, IN 47374

THE CONTRACTOR:
(Name, legal status and address)

TABLE OF ARTICLES

A.1 GENERAL

A.2 OWNER'S INSURANCE

A.3 CONTRACTOR'S INSURANCE AND BONDS

A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL

The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A201™–2017, General Conditions of the Contract for Construction.

ARTICLE A.2 OWNER'S INSURANCE

§ A.2.1 General

Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Document A201®–2017, General Conditions of the Contract for Construction. Article 11 of A201®–2017 contains additional insurance provisions.

§ A.2.2 Liability Insurance

The Owner shall be responsible for purchasing and maintaining the Owner's usual general liability insurance.

(Paragraphs Deleted)

(Table Deleted)

(Paragraphs Deleted)

(Table Deleted)

(Paragraphs Deleted)

(Table Deleted)

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self-insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect, and the Architect's consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, CG 20 32 07 04.

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than (\$) each occurrence, (\$) general aggregate, and (\$) aggregate for products-completed operations hazard, providing coverage for claims including

- .1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;
- .2 personal injury and advertising injury;
- .3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
- .4 bodily injury or property damage arising out of completed operations; and
- .5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

- .1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.
- .2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.
- .3 Claims for bodily injury other than to employees of the insured.
- .4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.
- .5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.
- .6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.
- .7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.
- .8 Claims related to roofing, if the Work involves roofing.
- .9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.
- .10 Claims related to earth subsidence or movement, where the Work involves such hazards.
- .11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than (\$) per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ A.3.2.5 Workers' Compensation at statutory limits.

§ A.3.2.6 Employers' Liability with policy limits not less than (\$) each accident, (\$) each employee, and (\$) policy limit.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks

§ A.3.2.8 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.2.9 If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.2.10 Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.2.11 Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.2.12 Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than (\$) per claim and (\$) in the aggregate.

§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:

(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.

(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

§ A.3.3.2.1 Property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:
(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

§ A.3.3.2.2 Railroad Protective Liability Insurance, with policy limits of not less than (\$) per claim and (\$) in the aggregate, for Work within fifty (50) feet of railroad property.

§ A.3.3.2.3 Asbestos Abatement Liability Insurance, with policy limits of not less than (\$) per claim and (\$) in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

§ A.3.3.2.4 Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

§ A.3.3.2.5 Property insurance on an "all-risks" completed value form, covering property owned by the Contractor and used on the Project, including scaffolding and other equipment.

§ A.3.3.2.6 Other Insurance

Init.

(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage

Limits

§ A.3.4 Performance Bond and Payment Bond

The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:

(Specify type and penal sum of bonds.)

Type

Penal Sum (\$0.00)

Payment Bond

Performance Bond

Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS

Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

Bid Bond

CONTRACTOR:

(Name, legal status and address)

SURETY:

(Name, legal status and principal place of business)

OWNER:

(Name, legal status and address)

Richmond Community Schools
Board of Trustees
300 Hub Etchison Parkway
Richmond, IN 47374

BOND AMOUNT: \$**PROJECT:**

(Name, location or address, and Project number, if any)

Richmond Community Schools
Richmond High School
Mechanical Modernization Project

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

Signed and sealed this day of ,

(Witness)

(Witness)

(Contractor as Principal)

(Seal)

(Title)

(Surety)

(Seal)

(Title)



AIA[®]

Document A312™ – 2010

Payment Bond

CONTRACTOR:

(Name, legal status and address)

SURETY:

(Name, legal status and principal place of business)

OWNER:

(Name, legal status and address)

Richmond Community Schools
Board of Trustees
300 Hub Etchison Parkway
Richmond, IN 47374

CONSTRUCTION CONTRACT

Date:

Amount: \$

Description:

(Name and location)

Richmond Community Schools
Richmond High School
Mechanical Modernization Project

BOND

Date:

(Not earlier than Construction Contract Date)

Amount: \$

Modifications to this Bond:

None

See Section 18

CONTRACTOR AS PRINCIPAL

Company:

(Corporate Seal)

Signature:

SURETY

Company:

(Corporate Seal)

Signature:

Name and

Title:

(Any additional signatures appear on the last page of this Payment Bond.)

Name and

Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

OWNER'S REPRESENTATIVE:

(Architect, Engineer or other party:)

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

- .1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
- .2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

- .1 the name of the Claimant;
- .2 the name of the person for whom the labor was done, or materials or equipment furnished;
- .3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
- .4 a brief description of the labor, materials or equipment furnished;
- .5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
- .6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
- .7 the total amount of previous payments received by the Claimant; and
- .8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

§ 16.4 **Owner Default.** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 **Contract Documents.** All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL

Company: _____
Signature: _____
(Corporate Seal)

SURETY

Company: _____
Signature: _____
(Corporate Seal)

Name and Title: _____
Address: _____

Name and Title: _____
Address: _____



AIA[®] Document A312™ – 2010

Performance Bond

CONTRACTOR:

(Name, legal status and address)

SURETY:

(Name, legal status and principal place of business)

OWNER:

(Name, legal status and address)

Richmond Community Schools
Board of Trustees
300 Hub Etchison Parkway
Richmond, IN 47374

CONSTRUCTION CONTRACT

Date:

Amount: \$

Description:

(Name and location)

Richmond Community Schools
Richmond High School
Mechanical Modernization Project

BOND

Date:

(Not earlier than Construction Contract Date)

Amount: \$

Modifications to this Bond:

None

See Section 16

CONTRACTOR AS PRINCIPAL

Company: *(Corporate Seal)*

Signature: _____

Name and

Title:

(Any additional signatures appear on the last page of this Performance Bond.)

SURETY

Company: *(Corporate Seal)*

Signature: _____

Name and

Title:

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:**OWNER'S REPRESENTATIVE:**

(Architect, Engineer or other party:)

ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

- .1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;
- .2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
- .3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

- .1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
- .2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

- .1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
- .2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and
- .3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 **Balance of the Contract Price.** The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 **Construction Contract.** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 **Contractor Default.** Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 **Owner Default.** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 **Contract Documents.** All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL

Company: _____
Signature: _____
(Corporate Seal)

Name and Title: _____
Address: _____

SURETY

Company: _____
Signature: _____
(Corporate Seal)

Name and Title: _____
Address: _____

Init.
/

SECTION 008160 – MODIFICATION TO GENERAL CONDITIONS

These Supplementary Conditions modify, change, delete from or add to the "General conditions of the Contract for Construction" AIA Document A201 / 2017 Edition, and are hereby made a part of the Contract. Where any Article of the General Conditions is modified or any Paragraph, Subparagraph, or Clause thereof is modified or deleted by these Supplementary Conditions, the unaltered provisions of that Article, paragraph, Subparagraph or Clause shall remain in effect.

ARTICLE 1 – GENERAL PROVISIONS

Add the following Subparagraph 1.1.1.1 as follows:

"The Contract Documents shall include the Bidding Documents such as the Invitation to Bid, the Instructions to Bidders, Sample Forms, the Contractor's Bid, all Addenda and other documents as specifically enumerated in the Owner-Contractor Agreement."

Add the following Subparagraphs 1.1.9 through 1.1.16:

1.1.9 The term "products(s)" as used in the Contract Documents refers to the materials, systems, and equipment provided by the Contractor for use in the Work of the Project.

1.1.10 The terms "warranty" and "guarantee" as used in the Contract Documents shall have the same meanings and shall be defined as "legally enforceable assurance of the duration of satisfactory performance or quality of a product or Work."

1.1.11 Where materials, systems, and equipment items are referred to in the singular, such reference shall not serve to limit the quantity required. Furnish quantities as required by the Contract Documents to complete the Work.

1.1.12 The Project Manuals are the volumes which include the Bidding Documents and Bid Forms; the Contracts, Conditions of the Contract and Division 1 - General Requirements, and the specifications noted on the drawings. Requirements set forth in the various sections of the Project Manual are interrelated and are binding on the Contractor in their entirety whether issued as one or multiple documents or volumes.

1.1.13 The term "Contractor" as used in the Contract Documents refers to the Contractor.

1.1.14 The general character and scope of the physical construction are shown by the drawings. Where a portion of the Work is fully drawn and the remainder is merely indicated, the portion fully drawn shall apply.

1.1.15 Calculated dimensions shall be followed in preference to scaled measurements. Dimensions on drawings and within the physical construction are subject to field verification.

1.1.16 Reasonable Time - Whenever a "reasonable time" is specified in any of the Contact Documents, the time allowed shall be forty eight (48) hours, weekends and holidays excluded, unless otherwise indicated or agreed upon. However, if it is necessary for any Contractor or Subcontractor to repair or replace any work after final acceptance of all work, the repair or replacement shall be done forthwith without regard for the foregoing provisions.

Add the following Subparagraphs 1.2.4, 1.2.5, and 1.2.6:

1.2.4 The limits of the Work shall not be restricted because of the arrangement of the Specifications. Where responsibility for particular work is required of a particular trade or contract, that trade or contract shall not be released from that responsibility by reason of the location of the specification working or drawing information which establishes the responsibility.

1.2.4.1 It is understood and agreed by the Contractor that the Work described in the Contract Documents is intended to be as complete as possible. The Contractor shall be held to provide all labor, equipment, materials, and related services necessary for the entire completion of the physical construction described in the Contract Documents and reasonably implied therefrom. The Contract Documents indicate the intended occupancy and utilization of the building and its individual systems, facilities, and components, and it is intended that the Contractor supply a building that is fit for the indicated use.

1.2.5 Should the Contract Drawings and Specifications be in disagreement with each other relative to quality or quantity of Work required, the better quality and/or the greater quantity shall govern, and shall be provided, unless instructions are otherwise furnished to the Contractor by the Architect in writing. If an item is shown on the Drawings, but not specified, the Contractor shall provide the item of a similar quality to other items specified, as determined by the Architect. If an item is specified but not shown on the Drawings, it shall be located as directed by the Architect.

1.2.5.1 Where a number is listed in the Contract Documents (as for gauges, weights, temperatures, amount of time, etc.) the number shall be interpreted as that or better. Variations must be requested in writing by the Contractor and must be approved in writing by the Architect.

1.2.6 The Contractor shall perform its duties hereunder with due diligence; in a good and workmanlike manner using new, good quality materials; in full compliance with the Drawings and Specifications; in accordance with all applicable laws, ordinances, and rules, and regulations.

1.5.2 After the last word "consultants," insert the phrase "which shall not be unreasonably withheld."

ARTICLE 2 - OWNER

Add the following Paragraph 2.6:

2.6 COST OF COMPLETION

2.6 Neither the Owner nor its officers, agents, employees, or representatives are in any way liable or accountable to the Contractor for the method by which completion of Work, or any portion thereof, is accomplished or for the price paid therefore. The Contractor is responsible for all costs of completing the work in excess of the Contract Sum. The Owner does not forfeit the right to recover damages from the Contractor for failure to complete the Contract by taking over the work or declaring the Contractor in default. Maintenance of the work remains the Contractor's responsibility.

ARTICLE 3 - CONTRACTOR

Add the following Subparagraph 3.2.2.1:

3.2.2.1 The Drawings shall not be scaled. Indicated or figured dimensions shall be followed: In case of any discrepancy in the figures, the Contractor shall bring the matter to the attention of the Architect for decision before proceeding with the Work. Failure to follow this procedure shall be at the Contractor's own risk.

To Subparagraph 3.4.1 add the following Clause 3.4.1.1:

3.4.1.1 The Contractor shall place orders for materials and equipment to be incorporated in the Work as soon as possible after award of the Contract and receipt of approvals where applicable. The Contractor shall keep the Architect informed as to availability of all specified materials and equipment.

Add the following Subparagraphs 3.4.4 and 3.4.5:

3.4.4 The Contractor agrees that neither he nor his subcontractors will discriminate against any employee or applicant for employment, to be employed in the performance of this Contract, with respect to hire, tenure, conditions, or privileges of employment, or any matter directly or indirectly related to employment, because of race, age, sex, color, religion, national origin, ancestry, or sexual orientation. Breach of this covenant may be regarded as a material breach of this Contract.

3.4.5 The Contract Sum will not be increased because of increases in labor rates, increases in material and equipment costs, and/or increases in equipment rental charges.

Add the following Subparagraphs to 3.5 as follows:

3.5.3 When so requested by the Architect, the Contractor and his Subcontractors and manufacturers or suppliers shall certify in writing that materials furnished by them comply with requirements described in Specifications and reference standards, including tests, and are so guaranteed by them. Certification shall be by affidavit from Contractor if so requested by the Architect.

3.5.4 As part of the Work, the Contractor shall properly adjust and regulate all systems and equipment so that such systems and equipment will function as intended; and it is understood that such systems and equipment cannot be properly regulated or adjusted until they are in actual use or operation.

3.5.5 The Contractor shall not be relieved of his general warranty obligation by the specification of a particular product or procedure.

3.5.6 The Contractor shall warrant all Work for a period of two years after the date established for substantial completion. Determination of this date shall be at the Architect's sole and absolute discretion and shall be final. The Contractor shall replace, without cost to the Owner or interference with Owner's operation, any defective workmanship or materials. All work shall be completed to the satisfaction of the Owner and Architect.

3.5.7 Manufacturers and fabricators of materials and products shall warrant their materials or products for a minimum period of one year after the date of substantial completion unless otherwise indicated in the Specifications. Owner may request such warranties in writing.

3.5.8 The responsibility for defective work shall not terminate at the end of the guarantee period. The Contractor shall continue to provide even beyond the two-year period, without limitation, such additional replacements or repairs required to correct all defective workmanship and materials for which written notice of the failure of compliance with Contract Documents has been given prior to the expiration of the two-year period.

3.5.9 The provisions contained in this paragraph 3.5 shall not be construed as restricting the Contractor's liability (or the Owner's right to recover damages) for breach of Contract by reason of non-conformance with the specifications or defects or faulty workmanship.

To Subparagraph 3.6 add the following Clauses 3.6.1, 3.6.2, 3.6.3, 3.6.4:

3.6.1 The Contractor shall pay all Social Security, unemployment and other taxes required by Federal, State, and Local Laws.

3.6.2 Contractors shall be responsible for informing themselves of tax laws, requirements, regulations, and interpretations as they apply to this Project.

3.6.3 Unless otherwise specified, the Contract Sum shall include all taxes applicable under tax laws in effect as of the date of Bid Opening, and which are applicable to the Work. If tax laws are subsequently amended by legislation, equitable net adjustment to the Contract Sum shall be made upon claim by either party involved. Separate Contractors and Subcontractors shall pay all taxes on materials, labor, or services furnished by them.

3.6.4 As provided in Clause 3.6.1, allowances shall include all applicable taxes, and failure by the Contractor to include applicable taxes shall not be cause to increase the Contract Sum.

Add the following Subparagraph 3.7.1:

3.7.1.1 The Contractor shall obtain and pay for a Certificate of Occupancy as required by governing authorities prior to final acceptance of the Project. Certificate shall be forwarded to the Owner.

3.7.1.2 LWC Incorporated will submit documents to the City and the Contractor shall obtain and pay for the General Building Permit as required by authorities having jurisdiction. All other permits, fees required by local authorities of the Contractor or his Sub-contractors shall be included with the Contractor's Bid. The Contractor shall obtain and pay for the "Occupancy Permit".

3.7.1.3 The Contractor shall obtain and pay for required "Tap in Fees".

3.7.1.4 The Contractor shall pay for the "Aid to Construction" charge.

Add the following Paragraph 3.10.4 and Subparagraphs 3.10.4.1 through 3.10.4.4:

3.10.4 When it becomes apparent from the weekly progress meeting that any activity completion date may not be met, the Contractor shall take some or all of the following actions at no additional cost to the Owner or the Architect:

3.10.4.1 Increase construction manpower in such quantities as will eliminate the backlog of work and put the Project back on schedule.

3.10.4.2 Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of construction equipment, or any combination of the foregoing as will substantially eliminate the backlog of work and put the project back on schedule.

3.10.4.3 Reschedule activities to achieve maximum practical concurrency of accomplishment of activities and put the Project back on schedule.

3.10.4.4 If a Contractor fails to take any of the above actions within forty-eight (48) hours after receiving written notice, the Owner may take action to attempt to put the Project back on schedule, and deduct the cost of such actions from the moneys due or to become due the Contractor.

To Subparagraph 3.12.2 add the following Clause 3.12.2.1:

3.12.2.1 All Work shall be furnished and installed in accordance with the Drawings, Specifications, and as additionally required by the manufacturer's printed instructions. The Contractor shall review the manufacturer's instructions, and where conflict occurs between the Drawings or Specifications and the manufacturer's instructions, the Contractor shall request clarification from the Architect prior to commencing the work.

Modify Subparagraph 3.12.8 as follows:

3.12.8 In the first sentence, delete the words "approved submittals" and substitute in lieu thereof the words "submittals reviewed by the Architect" and delete the words "Architect's approval" and substitute in lieu thereof the words "Architect's review". In last sentence, delete the words "Architect's approval" and substitute "Architect's review".

Add the following Subparagraph 3.12.8.1:

3.12.8.1 The Contractor shall provide full information to the manufacturer as to the relevant performance requirements and conditions under which materials, systems, or equipment will be expected to operate. Certifications received shall be in the form of a presentation or assurance of performance at the Project site.

Add the following Subparagraph to 3.14:

3.14.3 Contractor and his Subcontractors shall provide chases, holes, and openings which are in correct location and of proper size, in their own work as may be necessary for proper installation of their own and other Subcontractor's work. Subcontractors shall consult with Contractor and any other Subcontractors concerned regarding proper location and size of chases, holes, and openings. In case of failure to leave or cut same in place, the Contractor, or Subcontractor shall cut them afterwards at his own expense. No excessive cutting will be permitted nor shall any structural members be cut without the consent of the Architect.

3.14.4 Each Contractor shall protect his work from damage at all times in a proper manner, or as the Architect may direct. Erect all necessary barriers, furnish and keep lighted and required danger signals at night, employ necessary watch person when required and take every precaution to prevent injury to persons or property.

3.14.5 Each Contractor shall be responsible for any damage which may accrue to the property of any other Contractor connected with the work, or to adjacent private or public properties, or to any portion of the structure which in any way results from the acts or neglect of his employees.

3.14.6 No Contractor shall cut away any structure, or other parts, or in any case allow the same to be done without the full knowledge and consent of the Architect and shall be held responsible for any damage resulting from any violations of the provisions of this clause.

Add the following Subparagraph 3.15.3 through 3.15.7:

3.15.3 All other Contractors and Subcontractors shall deposit their debris in a dumpster. Each Contractor shall be responsible for the removals daily of his crates and cartons in which materials, equipment, or fixtures are received. Failure of a Contractor to do so will require that this be done by the Owner and labor for doing so be charged to responsible Contractor. Debris removed from work site will be transported to an acceptable disposal site. Any debris, mud, or deleterious material from the building site will be removed from said streets at the end of each working day, or before, if directed by the Local Authority.

3.15.4 At the completion of the project, the Contractor, in addition to removal to accumulated rubbish, shall clean all first floor glass, clean windows both sides, replace any broken glass, remove paint, remove stains, spots, and marks from finish work and hardware.

3.15.5 At the completion of the project, the Contractor shall clean all plumbing fixtures and equipment he installs, including any fixtures which were used during construction.

3.15.6 The Contractor shall clean all light fixtures, including lenses, and miscellaneous devices which will include removing bugs, debris, stains, rust, and dirt after the completion of the building. Re-lamp all repurposed/re-used fixtures. Re-lamp or furnish lamps to Owner for all fixtures used during construction.

3.15.7 The Contractor, at the completion of the work, shall remove all surplus material.

Add the following Subparagraph 3.18.3:

3.18.3 The Contractor shall be obligated to report errors or inconsistencies to the Architect and shall be liable for extra costs resulting from failure to give adequate notice of errors and inconsistencies.

Add the following Paragraph 3.19:

3.19 LABOR DISPUTES

3.19.1 The Contractor agrees to indemnify and hold the Owner and the Architect harmless from any and all losses or damages arising out of jurisdictional labor disputes or other labor troubles of any kind that may occur during performance of the Contract.

To Subparagraph 4.2 add the following Clauses 4.2.15, 4.2.16, 4.2.17:

4.2.15 The Architect will not be responsible for means and methods indicated by submittals.

4.2.16 The Architect will not be responsible for specified construction procedures. The Contractor shall be responsible for all construction means, methods, materials, and procedures. The Specifications may indicate or specify means, methods, and materials (including manufacturer's instructions, and reference codes and standards). Where the Architect makes such reference, it is merely to indicate a standard by which Work may be judged and to indicate means, methods, materials, and systems whose suitability has been demonstrated by standard construction practices and "Rules of the Trade", by certified test data, industry standards, governing regulations, and manufacturer's recommendations. The Contractor shall be responsible for making timely objections, proposing alternative, or making discrepancies known to the Architect when procedures and materials are specified.

4.2.17 Products, materials, or methods, etc., were selected by the Architect and are reasonably fit for the particular purpose and for the use indicated; and the Architect may rely on the sellers, manufacturers, fabricators, referenced standard, or Contractor's judgement regarding the specific uses of materials, methods, or equipment.

ARTICLE 5 - SUBCONTRACTORS

To Subparagraph 5.1.1 add the following Clause 5.1.1.1:

5.1.1.1 Material and equipment suppliers shall be included in the definition of Subcontractors.

Add the following Subparagraph 5.1.3:

5.1.3 If any Contractor, Subcontractor, or Sub-Subcontractor desires to obtain the services of any other Subcontractor or Sub-Subcontractor, the party hired to do the work shall become a Subcontractor or Sub-Subcontractor under the party who has hired him, and shall be subject to all provisions of the Contract Documents which pertain to Subcontractors and Sub-Subcontractors as applicable.

Add the following Subparagraph 5.2.5:

5.2.5 The Contractor shall submit, prior to the award of a Contract, to the Architect a list of the names of the Subcontractors proposed for all portions of the Work. The above list shall be submitted either on AIA Document G805 or on the Contractor's letterhead, in which case the list shall identify the work to be done, the firm's name, the address, the phone number, and the contact representative for each Subcontractor listed.

5.2.5.1 No Work shall be commended and no payment will be approved until the Architect has received the above noted list of Subcontractors.

Add the following Subparagraph 5.3.1:

5.3.1 All subcontracts shall be in writing and the Contractor shall be responsible for forwarding copies to the Architect or Owner upon request.

ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

To Subparagraph 6.1.3 add the following Clause 6.1.3.1:

6.1.3.1 The Contractor's cooperation, as required by Subparagraph 6.1.3 shall include, but not necessarily be limited to, requirements for phased construction, the Owner's phased occupancy and all other needs for the project.

Add the following Subparagraph 6.1.5:

6.1.5 Any use of the premises and partial occupancy by the Owner shall not be construed as an acceptance of any portion of the Work nor a waiver of any claims.

ARTICLE 7 - CHANGES IN THE WORK

Add the following to Subparagraph 7.1:

7.1.4 The Contractor shall promptly notify the Architect should the Contractor encounter any concealed condition which might result in a claim for adjustment of the Contract Sum including adjustment on the basis of established unit prices. Failure to promptly notify the Architect will waive the right of the Contractor to seek an increase in the Contract Sum.

7.1.5 The Contractor shall verify all information given prior to beginning his work. The Contractor shall make careful investigation to establish the exact location of items indicated on the Drawings. The Contractor shall be responsible for all costs arising out of damage to such items which result from his work.

7.1.6 The Contractor shall be alert to any indication or evidence of existing or concealed utilities not shown on the Drawings and shall notify the Architect of such evidence. If the Contractor encounters such utilities or structures he shall cease operations immediately to minimize damage, and shall notify the Architect. Cost of unavoidable initial damage, and such supplemental and remedial work which is ordered by the Architect, shall be borne by the Owner in accordance with the General Conditions. The Contractor shall bear the cost of damage resulting from his failure to exercise reasonable care in his work, or from continuing operations without notifying the Architect.

7.1.7 Contractors bidding on this work are encouraged to visit the site and determine all local conditions that may in any way affect their work.

7.1.8 After award of the Contract, no substitutions of manufacturer, products, materials, equipment, or technique will be considered unless a formal written request is submitted by the Contractor to the Architect and substantiated by one or more of the following conditions:

7.1.8.1 Required for compliance with code requirements or insurance regulations not existing at the time of award of the Contract.

7.1.8.2 Impossibility of supplying in conformance with the Contract Documents, through no fault of the Contractor.

7.1.8.3 Where the substitution would clearly serve the Owner's best interest, in terms of cost, time, value, or other consideration.

7.1.8.4 Represents that the Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;

7.1.8.5 Represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified;

7.1.8.6 Certifies that the cost data presented is complete and includes all related costs under this Contract but excludes costs under separate contracts, and excludes the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently become apparent; and

7.1.8.7 Will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

7.1.8.8 Substitution requests shall be timely, stating the reason why the substitution is being proposed and accompanied by complete data on the proposed substitution, substantiating compliance with the Contract Documents including product identification and description; drawings and catalog cuts; performance and test data, references and samples where applicable; and an itemized comparison of the proposed substitution with that as originally specified along with data relating to other portions of the work and the effect of such substitution on the Contract time schedule, design and artistic effect where applicable, and its relationship or effects on separate Contracts, if any; and accurate cost data on the proposed substitution in comparison with that as originally specified whether or not modification of the Contract Sum is to be a consideration.

7.1.8.9 The Architect shall be the judge of all proposed substitutions and his decision shall be final. Acceptable changes shall be incorporated in the Contract by Change Order, by Shop Drawings in accordance with Subparagraph 3.12.8, or other written order.

7.1.9 By making requests for substitutions, the Contractor:

7.1.9.1 Represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that originally specified.

7.1.9.2 Represents that he shall provide the same guarantee or warranty for the substitution that would be required for the item originally specified;

7.1.9.3 Certifies that the cost data presented is complete and includes all related costs under this Contract but excludes costs under Separate Contracts, and excludes the Architect's re-design costs, and further waives all claims for additional costs related to the substitution which subsequently become apparent; and,

7.1.9.4 Shall coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

7.1.10 Substitutions will not be considered if:

7.1.10.1 They are indicated or implied on Shop Drawings, Product Data, or Sample submissions without the formal written request required in applicable Subparagraph above; or,

7.1.10.2 For their implementation they require a substantial revision of the Contract Documents or work of the Owner or separate contractors in order to accommodate their use.

To Subparagraph 7.2.1 add the following Clauses 7.2.2, 7.2.3, and 7.2.4:

7.2.2 If requested, the Contractor shall submit to the Architect a detailed breakdown.

7.2.3 CHANGE ORDER PRICING GUIDELINES

- A. Labor - all field labor expended by the Trade Contractor at the base rate without fringe benefits. The payroll to be based on straight time (if overtime is needed, it should be included in the proposal), and to include number of hours and rate for each item in Bulletin.
- B. All establishing payroll taxes, assessments and fringe benefits. This may include Bond, FICA, Federal Unemployment, Local Health and Welfare, Local Pension Fund, State Unemployment Workers' Compensation, Public Liability and Property, Local Apprentice Fund. Each of these categories is to be a separate line item.
- C. Rental:
Heavy equipment and trucking.
- D. Travel Expense:
 - 1. Travel expense for men brought to the job specifically for this work.
- E. Overhead:
 - 1. Overhead on Items A, B, C, D: 10 percent.
- F. Materials:
 - 1. All materials purchased by the Trade Contractor for this work.
 - 2. Agreed on value of materials taken from the Contract work, either as used or unused new materials.
- G. Profit on Items A, B, C, D, E, F: 5 percent.
- H. All Trade Subcontractor labor and material (enclose quotations).
- I. Trade Subcontractor Overhead and Profit: 8 percent
- J. Other reimbursable items - (without overhead or profit):
 - 1. Extra "out of pocket" insurance premiums, job connected.
 - 2. Telephone, telegrams, photos, etc.
 - 3. Fees for permits, licenses, inspections, etc.
 - 4. Premium payments for overtime work or special conditions.
- K. The use of the Trade Contractors' small tools, light weight equipment, gear, simple scaffolds, etc., shall be considered a part of the overhead cost.
- L. The Architect reserves the right to approve items entering into the "actual field cost" before commitments are made.
- M. The Owner has the right to audit the Contractor's records insofar as the "line item cost" work is concerned.

7.2.4 Proposals are submitted to the Architect on the approved form. Attached to Proposal shall be an Itemized Breakdown of each Item Applicable A through L used in preparing Estimate.

ARTICLE 8 - TIME

To Subparagraph 8.1.1 add the following Clause 8.1.1.1:

8.1.1.1 The Contract Time is a period of time allotted in the Contract Documents for the Substantial completion of all Work as defined in Subparagraph 8.1.3, including authorized adjustments thereto. The Contract Time includes the time required for clean up and preparation for Owner move in. The time required for Contractor shall be in accordance with the durations established in the Progress Schedule.

To Subparagraph 8.1.2 add the following Clause 8.1.2.1:

8.1.2.1 Notice to proceed will be issued to the Contractor. The Contractor shall obtain insurance and permits, file documents, and notices as required and necessary, and shall commence the Work immediately.

Add the following Subparagraphs 8.2.4 and 8.2.5:

8.2.4 Each Contractor and Subcontractor shall prosecute the work regularly and diligently at a rate of progress that maintains the Project Schedule and that insures the achievement of Substantial completion and the issuance of a "Certificate of Substantial Completion" no later than that date specified by the Project Schedule.

8.2.5 The items listed in the Architect's Certificate of Substantial Completion to be completed or corrected shall be completed by the Contractor and Subcontractor within 10 days after the Owner's and Contractor's written acceptance of the responsibilities assigned to them in such Certificate, as stated in Paragraph 9.8 of the General Conditions. Items not completed or corrected within 10 days of the date of Substantial Completion shall be completed or corrected by the Contractor and Subcontractor within the next 30 days but only during non-business hours of the Owner's facility, at no additional cost to the Owner.

8.3.1 Delete the term "arbitration".

To Subparagraph 8.3.1 add the following Clauses 8.3.1.1 and 8.3.1.2:

8.3.1.1 Wherever any provisions of any Section of the Contract Documents conflict with any agreements or regulations of any kind at any time in force among members of any Trade Associations, Unions, or Councils which regulate or distinguish what work shall or shall not be included in the work of any particular trade, the Contractor shall make all necessary arrangements to reconcile any such conflict without delay, recourse, damage, or cost to the Owner or the Architect.

8.3.1.2 In case the progress of the Work is affected by any undue delay in furnishing or installing any items of material or equipment required under the Contract Documents because of a conflict involving any such Labor Union agreement or regulation, the Owner or Architect may require that other material or equipment of equal kind or quality be provided at no additional cost to the Owner or Architect.

Add the following Subparagraphs 8.3.4, 8.3.5, 8.3.6, and 8.3.6:

8.3.4 Contractor's written claims for extension of time shall be accompanied by detailed dates, correspondence, notices, and other data which provide proof of the events which are the basis for the claim.

8.3.5 Delays due to tardy shop drawings submittal, tardy material ordering, or shipment, or any other delays caused by a supplier or a Subcontractor of the Contractor shall not be deemed valid causes for delay and shall not be accepted as a basis for claims for extension of time, as the scheduling and control of suppliers and Subcontractors is a part of each Contractor's responsibility.

8.3.6 Time extensions will be granted for legitimate cause to a Contractor on an individual basis. Granting of a time extension to one Contractor does not imply nor will it necessarily constitute the granting of similar time extensions to other contractors. Extensions of time, when granted, will be by written Change Order, which shall be the only valid form. Where a change in the Work is ordered by written Change Order, any agreed upon extension of time required because of the change in the Work shall be a part of the Change Order. No extension of time will be granted subsequent to the execution of a change order, on account of work which is changed by said Change Order. Permitting the Contractor to continue and finish the work after the dates to which the time for completion may have been extended, shall in no way operate as a waiver on the part of the Owner of any of his rights under the Contract.

Add the following Paragraph 8.4 and related Subparagraphs 8.4.1 through 8.4.6:

8.4 RECOVERY OF DAMAGES

8.4.1 It is hereby understood and mutually agreed, by and between the Contractor and the Owner, that the date of beginning and the time for completion as specified in the Contract, of the work to be done hereunder, are essential conditions of this Contract; and it is further mutually understood and agreed that the work embraced in this Contract shall be commenced on a date to be specified in the Notice to Proceed.

8.4.2 The Contractor agrees that said work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the Owner, that the time for the completion of the work described herein is an achievable time for the completion of the same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

8.4.3 There is no liability for damages upon work resulting from delay caused by third persons which is not the result of interference on the part of the Owner as a contracting party. Any loss that may ensue that is caused by the failure of the Contractor to finish his work at a scheduled time is the responsibility of the Contractor.

8.4.4 It is further agreed that time is of the essence of each and every portion of this Contract and of the Specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall be of the essence of this Contract provided that the Contractor shall not be charged with damages when the delay in completion of the work is due:

1. To any preference, priority, or allocation order duly issued by the Government.
2. To unforeseeable cause beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, or the public enemy, acts or omissions of another Contractor in the performance of a Contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather; and

3. To any delays by Subcontractors or Suppliers occasioned by any of the causes specified in 1 and 2 of this Subparagraph.
4. To a stop work order which may only be issued by the Owner or the Architect with a copy of the order sent by registered mail.
5. To sizable Change Orders that affect timing and cause delays that involve extra work on the part of the Contractor.

Provided further, that the Contractor shall, within twenty (20) days from the beginning of such delay, inform the Architect in writing of the cause of delay. Within fifteen (15) days of the Contractor's request, the Architect will recommend or approve with comments concerning data or circumstances for the delay. Delay time will be evaluated near the completion of the Project and consideration will then be given for any extensions the Owner believes have been justified.

ARTICLE 9 - PAYMENTS AND COMPLETION

To Subparagraph 9.3.1 add the following Clause 9.3.1.3:

9.3.1.3 Pay application to be submitted on AIA G703.

Add the following Subparagraphs 9.3.4, 9.3.5, 9.3.6, and 9.3.7:

9.3.4 Until the Work is 50 percent (50%) complete, the Owner will pay 90 percent (90%) of the amount due the Contractor on account of progress payments for labor. There shall be paid to the Contractor a sum at the rate of 90% of the invoice costs, not to exceed the bid price for material delivered to the site or other approved storage area, but not incorporated into the work. At the time the Work is 50 percent complete and thereafter, if the manner of completion of the Work and its progress are and remain satisfactory to the Architect and Owner and in the absence of other good and sufficient reasons, the Architect with the consent of the Owner, will (on presentation by the Contractor of Consent of Surety for each Application) and at the request of the Contractor, may, at his discretion, deduct the increment retained in connection with any subsequent progress payments, or make any subsequent progress payments in full. Unconditional waiver of lien must be included with pay application.

9.3.4.1 The full retainage of 10% of the entire Contract Amount may be reinstated if the manner of completion of the Work and its progress do not remain satisfactory to the Owner, or the Architect, or if the Surety withholds its consent, or for other good and sufficient reasons.

9.3.5 The Contractor shall pay for transportation, services, materials, tools, expendables, and subcontract work. Each payment shall be in an amount equal to the percentage of completion allowed to the Contractor for each item or category, less the same percentage retained from payments to the Contractor.

9.3.6 In order to facilitate the Contractors' timely ordering and delivery of materials so as to minimize the Contractor's difficulties which could arise out of failure to have proper materials and equipment on hand when needed for construction, the Owner will make payment on account of materials or equipment not incorporated in the Work, but delivered and suitably stored at some other location, if prior approval has been obtained from the Architect for such storage. Owner's payment will be contingent upon receipt of the Contractor's statement of responsibility in a form acceptable to the Owner. The Owner's payment for off-

site stored materials will not include the Contractor's overhead and profit. Contractor's statement of responsibility shall as a minimum:

9.3.6.1 Accurately describe the material and/or equipment for which payment is being requested.

9.3.6.2 State the amount of payment being requested. The amount of payment being requested shall not include the Contractor's overhead and profit.

9.3.6.3 Be accompanied by such invoices or bills of sale as the Owner or Architect requires in order to verify the amount of payment being requested.

9.3.6.4 Identify the location of the off-site storage.

9.3.6.5 Be accompanied by a Certificate of Insurance showing type and limits of coverage acceptable to the Owner.

9.3.6.6 Include a statement by the Contractor agreeing that the Owner's payment for off-site stored material and/or equipment in no way relieves the Contractor from performing all the Work required by the Contract Documents, and further, indemnifying the Owner against all damages, losses, and expenses arising out of any circumstance associated with loss of damage of off-site stored materials for which the Owner makes payment.

9.3.6.7 Be signed by a person who is authorized to sign agreements on behalf of the Contractor, said signature being witness by a Notary Public.

9.3.7 Contractor shall be fully responsible for all procedures necessary to protect himself from damages, losses, and expenses arising out of loss or damage to off-site stored materials for which the Owner has made payment, which procedures may include but not limited to Bonded Warehousing, adequate insurance, etc.

In Subparagraph 9.5.1 add the following to the list concerning the withholding of payments:

- .8 Erroneous estimates by the Contractor of the value of the work performed.
- .9 Unauthorized deviations by the Contractor from the Contract Documents.
- .10 Failure of the Contractor to provide record documents.
- .11 Failure to provide materials and subcontractor list prior to initial pay request.
- .12 Failure to provide and update Progress Schedule.
- .13 Failure to provide contract cost breakdown prior to first pay request.
- .14 Failure to provide a neat, error-free, legible request; one copy of which must be an "original" copy.
- .15 Failure to keep record documents up to date on a monthly basis.
- .16. Funds may also be withheld on account of damages resulting from the Contractor's failure to give notice of errors and consistencies.

Delete Subparagraph 9.10.4 entirely.

Add Subparagraph 9.10.6

9.10.6 The acceptance by the Contractor of final payment shall further constitute a release of the Owner and Architect from all uninsured liability for all things done or furnished in connection with the Work and for every uninsured act of omission or neglect by the Owner and Architect relating to or arising out of the

Work. Each Contractor, before final payment, shall also execute and deliver a general release to the Architect of all liability as set forth in the preceding sentence.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

To Subparagraph 10.1 add the following Clause 10.1.1:

10.1.1 Contractor shall provide methods and equipment for protecting the building, all materials, and personnel from fire damage prior to starting work. Methods and equipment are subject to approval of the local fire department or State Fire Marshal which shall have jurisdiction.

Delete Subparagraph 10.2.8 and substitute the following:

10.2.8 If any party suffers injury or damage to person or property because of an act or omission of another party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK

Subparagraph 12.2.2.3: Remove the word “not.”

Add the following Subparagraph 12.2.6:

12.2.6 In the case of minor repairs to newly finished interior surfaces of the building (not covered by Property Insurance), the cost of said repairs shall be pro-rated to the Contractors in proportion to the manpower employed during the period when the damage occurred if the Contractor causing the damage is unknown. The Architect will endeavor to determine the Contractor or other parties responsible for damage, but inability to determine responsibility shall in no way waive the Architect's right to pro-rate repair costs.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1 Insert a period (.) after the word “located”. Delete the paragraph after that period.

To Subparagraph 13.1 add the following clause 13.1.1:

13.1.1 The governing law shall mean codes or regulations of the State, County, and local municipality where the Project is situated; also, any regulation or requirement of utility companies and insurance companies having jurisdiction of the Work, whether insurance companies having jurisdiction of the Work, whether such regulations are legally mandatory or not, if same are binding upon the Owner. Each trade engaged on the Project shall also be bound by National Codes and standards which apply to materials and practices applying to such respective trades. If, and to the extent that any provision of this contract shall be unlawful or contrary to public policy, the same shall not be deemed to invalidate or otherwise affect the other provisions hereof.

ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

Delete Subparagraph 14.1.1 and substitute the following:

14.1.1 If work is stopped for a period of 30 days under any order of a court or any public authority having jurisdiction, or as a result of any act of government, such as declaration of national emergency making materials unavailable, through no act or fault of the Contractor or subcontractor or their agents or employees or any other persons performing any of the work under a contract with the Contractor, then the Contractor may, upon seven days written notice to the Owner and Architect, terminate the Contract and recover from Owner payment for all work executed and for any proven loss resulting upon any material, equipment, tools, construction equipment and machinery, including reasonable profit.

To Subparagraph 14.2.1 add the following:

- .5 Failure to complete the work within the Contract Time or any extension thereof.
- .6 Failure or refusal to comply with any directive of the Architect within a reasonable time.
- .7 Failure or refusal to remove rejected materials.
- .8 Failure or refusal to perform anew any defective or unacceptable work.
- .9 Bankruptcy or insolvency, or making of an assignment for the benefit of creditors.
- .10 Failure to provide qualified superintendent, or subcontractors to carry on the work in an acceptable manner.
- .11 Failure to prosecute the work according to agreed schedule of completion.

In the event of termination pursuant to Paragraph 14.2.1, Contractor shall, if requested, promptly assign to Owner such of Contractor's subcontracts as Owner may request, and Contractor shall remove such materials, tools, and equipment used by Contractor in the performance of the work as Owner may direct."

Add the following Subparagraph 14.2.3.1:

14.2.3.1 Where the Contractor's services have been so terminated by Owner, said termination shall not affect any rights of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys by Owner due Contractor shall not release Contractor from liability.

To subparagraph 15.1.1 add the following Clause 15.1.1.1:

15.1.1.1 Claims for additional cost arising out of an error or inconsistency shall be denied where the Contractor has failed to review the documents or report the error or inconsistency.

Delete Subparagraph 15.1.7 entirely.

15.2.5 Insert a period (.) after the phrase "but subject to mediation" and delete the remainder of that sentence.

15.2.6.1 Insert a period (.) after the word "mediate." Delete the remaining sentence after that period.

15.3.1 Delete references to Paragraphs 9.10.4 and 15.1.7.

15.3.2 Delete the paragraph starting with the sentence "The request may be made concurrently with the filing of binding dispute resolution proceedings but ..."

15.4 ARBITRATION – Delete this article entirely.

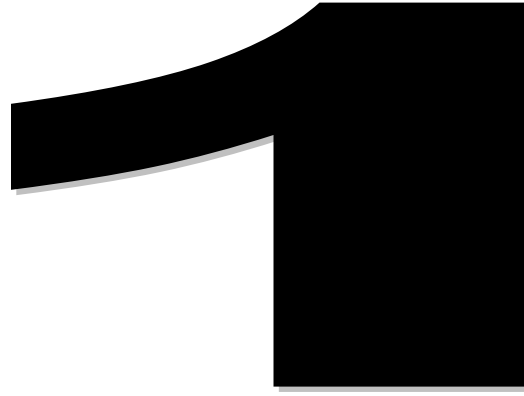
Add the following Article 16:

16.1 COMMITMENT TO ECONOMIC INCLUSION AND DIVERSITY

16.1.1 Each Contractor shall be committed to maximizing contracting and subcontracting opportunities for qualified businesses who are certified by an organization or entity or who subcontract with businesses so certified, in one of the following categories: Small Business Enterprise (“SBE”), Minority-Owned Enterprise (“MBE”), or Woman-Owned Enterprise (“WBE”) (collectively referred to as "certified diverse businesses").

END OF SECTION 000816

DIVISION



GENERAL CONDITIONS

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Project information.
- 2. Work covered by Contract Documents.
- 3. Access to site.
- 4. Coordination with occupants.
- 5. Work restrictions.
- 6. Specification and drawing conventions.
- 7. Miscellaneous provisions.

- B. Related Requirements:

- 1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Richmond High School Mechanical Modernization

- 1. Project Location: Richmond High School
380 Hub Etchison Parkway
Richmond, IN 47374

- B. Owner: Richmond Community Schools
300 Hub Etchison Parkway
Richmond, Indiana 47374

- 1. Owner's Representative: Glen Slifer & John Hamilton

- C. Architect: LWC, Inc.
712 East Main Street
Richmond, Indiana 47374

- 1. Contact: Kevin R. McCurdy

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

- Removal of the existing steam boilers and replacement with hydronic boilers.
- Removal of two existing chillers and replacement with three new chillers and cooling towers.
- Replacement of steam piping in the tunnels from central plant throughout the building to where steam to hydronic heat exchangers are located.
- Replacement of all systems associated with the natatorium.
- Replacement of steam components in room east of the Library.
- There is an alternate to replace equipment and VAV boxes through the area of the Library.
- There is an alternate to replace finishes in the classrooms adjacent to the Library, including painting, flooring, new ceiling pads, replacement of chalkboards with markerboards, and new roller shades.
- Replacement of fencing and minor civil work around the location of the cooling towers.
- There is an alternate for additional demolition and grading south of the central plant where a chiller is being removed.
- A portion of roof over the natatorium will be replaced where new rooftop equipment is being mounted.
- There is miscellaneous exterior trim work around the perimeter of the natatorium.

B. Type of Contract:

1. Project shall be constructed under a single prime contract.

1.5 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to rooms where work is indicated.
2. Driveways, Walkways and Entrances: Keep driveways, parking lots, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.6 COORDINATION WITH OCCUPANTS

- A. Owner Occupancy: Owner will occupy site and existing building during entire construction period. This includes portions of the building during the summer for summer school and other community activities in and around the building. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 2. Notify Owner not less than 72 hours in advance of the following activities:
 - a. Any noise-generating activities anticipated during times when the building will be occupied.
 - b. Any activity that will affect full functionality of the fire alarm system in any area of the building.
 - c. Disruption of any building utilities.
 - d. Closure of any means of egress pathway or exit from the building.
 - e. Any rigging or other activities that might involve the use of crane and/or other overhead activities with significant loads.
 - f. Any change to the two-week outlook schedule of activities.

1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Work may be performed during nights, weekends, and holidays with limited restrictions. Work performed during summer school hours shall be limited to areas not utilized by staff, students, or community organizations. A list of scheduled activities by area that will affect work included in the Scope of this project will be provided by the Owner at least one month in advance of those activities. All Work performed during the regular school calendar shall be scheduled for times when school is not in session. Additional restrictions may be required based on special after school activities. The Contractor shall notify the Owner a minimum of 72 hours prior to any deviation from a change in the bi-weekly schedule.
- B. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. No activities that generate noise, vibration, and/or odors shall be performed during school hours during the normal school year.
 2. All such activities shall be performed between the hours of 4:00 pm and 7:00 am on school days.
 3. Notify Architect and Owner not less than three days in advance of proposed disruptive operations.
 4. Obtain Owner's written permission before proceeding with disruptive operations.

- C. Rigging and Crane Work: Coordinate operations that significant overhead loads with Owner.
 - 1. No rigging work or the use of cranes shall be performed during school hours during the normal school year.
 - 2. All such activities shall be performed between the hours of 4:00 pm and 7:00 am on school days.

- D. Removal of existing Chillers.
 - 1. There are year-round activities require at least one chiller to remain active. Accommodations must be made for at least one chiller to remain active for the duration of the Project. This may include temporary relocation of existing chiller(s) as indicated on the Phasing Plans. The Owner is open to alternative options proposed by the Contractor as long as the need for year-round cooling is met.

- E. Removal of existing Boilers.
 - 1. Removing the existing steam boilers is critical to all other Central Plant work to make room for the new boilers and chillers inside the building. Coordinate the timing of removal with the Owner. The times provided on the Phasing Plans are approximate and must be coordinated with actual weather conditions and the timing of new equipment delivery.

- F. Temporary Space Conditioning.
 - 1. Any equipment or other provisions required to provide temporary space conditioning, either heating or cooling, to any area of the building as a result of the work of this Project, shall be the responsibility of the Contractor, Subcontractor, and/or Vendors to provide. The Owner shall not be responsible for the means and methods of the Project and the potential need for temporary space conditioning due to the sequence of Work.

- G. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.

- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

1. Alternate No. 01 – Additional Scope at Existing South Chiller Location.
 - a. Base Bid Work shall include complete removal of the chiller south of Central Plant, including all associated electrical and piping. Existing concrete pad, foundations, wood fence, installation of topsoil to match surrounding grades, and restoration of lawn shall be by Owner under separate Contract.
 - b. Alternate Bid Work shall include complete removal of the chiller south of Central Plant, including all associated electrical, piping, concrete pad, foundations, wood fence, installation of topsoil to match surrounding grades, and restoration of lawn.

2. Alternate No. 02 – Additional Classroom Finishes.
 - a. Base Bid Work shall include repair, full prime paint, and two-coat finish paint all walls, ceilings, and other surfaces, in all locations as required for removal and installation of new plumbing, mechanical, and electrical items only in Classroom L113, Classroom L111, Classroom L110, Classroom L109, Classroom L106, Computer Lab L104, Office R121, Classroom R123, Office R123A, Storage R124, Room R128, Room R128A and Room R129. All walls where repairs and painting are required due to removal of plumbing, mechanical, and/or electrical items shall have all damaged areas repaired, whether the result of this project or not, and shall be fully primed and two-coat finish painted corner to corner and floor to ceiling.
 - b. Alternate Bid Work shall include repair, full prime paint, and two-coat finish paint all walls, replacement of all suspended acoustical ceiling tile, replacement of all carpet and vinyl base, installation of new markerboards and tackboards as indicated, and installation of new roller shades in Classroom L113, Classroom L111, Classroom L110, Classroom L109, Classroom L106, Computer Lab L104, Office R121, Classroom R123, Office R123A, Storage R124, Room R128, Room R128A and Room R129.

3. Alternate No. 03 – Additional Mechanical Scope at Unit C.
 - a. Base Bid Work shall limit work in Unit C to those rooms with existing steam heat, including Office R121, Classroom R123, Office R123A, Storage R124, Room R128, Room R128A and Room R129. All associated work, including additional plumbing, mechanical, electrical, and finish scope required to convert these spaces from steam to a hydronic system, shall be included.
 - b. Alternate Bid Work shall add all plumbing, mechanical, and electrical work as indicated in Unit C, in addition to the work included with the Base Bid scope.

4. Alternate No. 04 – Add New Equipment in Fan Room L103 at Unit C.
 - a. Base Bid Work shall maintain all existing equipment in Fan Room L103. No additional equipment shall be provided, including the AHU-1C, new rooftop unit ERV-1 and all new ductwork associated with new equipment connections to existing ductwork. The structural and roof work required to provide a new roof opening for ERV-1 shall not be included in the Base Bid. All new work in the area of Unit C shall be fed from the existing units.
 - b. Alternate Bid Work shall include all plumbing, mechanical, and electrical work as indicated in Fan Room L103, including the AHU-1C, new rooftop unit ERV-1 and all new ductwork associated with new equipment connections to existing ductwork. The structural and roof work required to provide a new roof opening for ERV-1 shall be included in the Alternate Bid.

5. Alternate No. 05 – Extend ceiling and lighting replacement in hall around pool.
 - a. Base Bid Work shall leave existing ceiling and lights in Corridor T270 and Corridor T271 as-is.
 - b. Alternate Bid Work shall remove plaster ceiling and replace with new acoustical ceiling and LED fixtures in Corridor T270 and Corridor T271 to match Corridor T165.

6. Alternate No. 06 – Alternate Controls Contractor.
 - a. Base Bid Work shall utilize any acceptable controls contractor listed in specifications.
 - b. Alternate Bid Work shall utilize Automated Logic Controls for the controls contractor.

END OF SECTION 012300

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 10 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

- a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the first day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.

3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 1. List of subcontractors.
 2. Schedule of values.
 3. Copies of building permits.
 4. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 5. Initial progress report.
 6. Report of preconstruction conference.
 7. Certificates of insurance and insurance policies.
 8. Performance and payment bonds.
 9. Data needed to acquire Owner's insurance.

- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Requests for Information (RFIs).
 - 3. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of the schedule of values.
 2. Delivery and processing of submittals.
 3. Progress meetings.
 4. Preinstallation conferences.
 5. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 2. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number.
1. Project name.
 2. Name and address of Contractor.

3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct weekly meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Critical work sequencing and long-lead items.
 - c. Designation of key personnel and their duties.
 - d. Lines of communications.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.

- j. Submittal procedures.
 - k. Use of the premises and existing building.
 - l. Work restrictions.
 - m. Working hours.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Procedures for moisture and mold control.
 - q. Procedures for disruptions and shutdowns.
 - r. Construction waste management and recycling.
 - s. Parking availability.
 - t. Office, work, and storage areas.
 - u. Equipment deliveries and priorities.
 - v. First aid.
 - w. Security.
 - x. Progress cleaning.
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Possible conflicts.
 - i. Compatibility requirements.
 - j. Time schedules.
 - k. Weather limitations.
 - l. Manufacturer's written instructions.
 - m. Warranty requirements.
 - n. Compatibility of materials.
 - o. Acceptability of substrates.
 - p. Temporary facilities and controls.
 - q. Space and access limitations.
 - r. Regulations of authorities having jurisdiction.
 - s. Testing and inspecting requirements.
 - t. Installation procedures.

- u. Coordination with other work.
 - v. Required performance results.
 - w. Protection of adjacent work.
 - x. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
 - 1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

- b. Digital Drawing Software Program: The Contract Drawings are available in AutoCad or dwg. format.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.

- i. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - j. Number and title of appropriate Specification Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Other necessary identification.
4. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.
- a. Transmittal Form for Paper Submittals: Use AIA Document G810 or Contractor's standard form.
 - b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
 - 1) Project name.
 - 2) Date.
 - 3) Destination (To:).
 - 4) Source (From:).
 - 5) Name and address of Architect.
 - 6) Name of Contractor.
 - 7) Name of firm or entity that prepared submittal.
 - 8) Names of subcontractor, manufacturer, and supplier.
 - 9) Category and type of submittal.
 - 10) Submittal purpose and description.
 - 11) Specification Section number and title.
 - 12) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - 13) Drawing number and detail references, as appropriate.
 - 14) Indication of full or partial submittal.
 - 15) Transmittal number, numbered consecutively.
 - 16) Submittal and transmittal distribution record.
 - 17) Remarks.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. Remarks.
 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
 - 3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.

4. Submit Product Data before or concurrent with Samples.
 5. Submit Product Data in the following format:
 - a. PDF electronic file or
 - b. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file or
 - b. Three opaque copies of each submittal. Architect will retain one copy; remainder will be returned.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- E. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
- F. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- G. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- H. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- I. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

- K. **Manufacturer Certificates:** Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- L. **Product Certificates:** Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. **Material Certificates:** Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. **Material Test Reports:** Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- O. **Product Test Reports:** Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- P. **Research Reports:** Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- Q. **Preconstruction Test Reports:** Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- R. **Compatibility Test Reports:** Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- S. **Field Test Reports:** Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- T. **Design Data:** Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 - 8. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 9. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 10. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 11. AGA - American Gas Association; www.aga.org.
 - 12. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 13. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 14. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 15. AIA - American Institute of Architects (The); www.aia.org.
 - 16. AISC - American Institute of Steel Construction; www.aisc.org.
 - 17. AISI - American Iron and Steel Institute; www.steel.org.
 - 18. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 - 19. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 - 20. ANSI - American National Standards Institute; www.ansi.org.
 - 21. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 - 22. APA - APA - The Engineered Wood Association; www.apawood.org.

23. APA - Architectural Precast Association; www.archprecast.org.
24. API - American Petroleum Institute; www.api.org.
25. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
26. ARI - American Refrigeration Institute; (See AHRI).
27. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
28. ASCE - American Society of Civil Engineers; www.asce.org.
29. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
30. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
31. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
32. ASSE - American Society of Safety Engineers (The); www.asse.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASTM - ASTM International; (American Society for Testing and Materials International); www.astm.org.
35. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
36. AWEA - American Wind Energy Association; www.awea.org.
37. AWI - Architectural Woodwork Institute; www.awinet.org.
38. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
39. AWPA - American Wood Protection Association; (Formerly: American Wood-Preservers' Association); www.awpa.com.
40. AWS - American Welding Society; www.aws.org.
41. AWWA - American Water Works Association; www.awwa.org.
42. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
43. BIA - Brick Industry Association (The); www.gobrick.com.
44. BICSI - BICSI, Inc.; www.bicsi.org.
45. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.com.
46. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
47. BOCA - BOCA; (Building Officials and Code Administrators International Inc.); (See ICC).
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bwfbadminton.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics & Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.

63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; www.ec-central.org.
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECA).
73. EIA - Electronic Industries Alliance; (See TIA).
74. EIMA - EIFS Industry Members Association; www.eima.com.
75. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
76. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
77. ESTA - Entertainment Services and Technology Association; (See PLASA).
78. EVO - Efficiency Valuation Organization; www.evo-world.org.
79. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
80. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
81. FM Approvals - FM Approvals LLC; www.fmglobal.com.
82. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
83. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
84. FSA - Fluid Sealing Association; www.fluidsealing.com.
85. FSC - Forest Stewardship Council U.S.; www.fscus.org.
86. GA - Gypsum Association; www.gypsum.org.
87. GANA - Glass Association of North America; www.glasswebsite.com.
88. GS - Green Seal; www.greenseal.org.
89. HI - Hydraulic Institute; www.pumps.org.
90. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
91. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
92. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
93. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
94. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
95. IAS - International Approval Services; (See CSA).
96. ICBO - International Conference of Building Officials; (See ICC).
97. ICC - International Code Council; www.iccsafe.org.
98. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
99. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
100. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
101. IEC - International Electrotechnical Commission; www.iec.ch.
102. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
103. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
104. IESNA - Illuminating Engineering Society of North America; (See IES).
105. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
106. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.

107. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
108. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
109. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
110. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
111. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
112. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
113. ISO - International Organization for Standardization; www.iso.org.
114. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
115. ITU - International Telecommunication Union; www.itu.int/home.
116. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
117. LMA - Laminating Materials Association; (See CPA).
118. LPI - Lightning Protection Institute; www.lightning.org.
119. MBMA - Metal Building Manufacturers Association; www.mbma.com.
120. MCA - Metal Construction Association; www.metalconstruction.org.
121. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
122. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
123. MHIA - Material Handling Industry of America; www.mhia.org.
124. MIA - Marble Institute of America; www.marble-institute.com.
125. MMPA - Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); www.wmmpa.com.
126. MPI - Master Painters Institute; www.paintinfo.com.
127. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
128. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
129. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
130. NADCA - National Air Duct Cleaners Association; www.nadca.com.
131. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
132. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
133. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
134. NCMA - National Concrete Masonry Association; www.ncma.org.
135. NEBB - National Environmental Balancing Bureau; www.nebb.org.
136. NECA - National Electrical Contractors Association; www.necanet.org.
137. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
138. NEMA - National Electrical Manufacturers Association; www.nema.org.
139. NETA - InterNational Electrical Testing Association; www.netaworld.org.
140. NFHS - National Federation of State High School Associations; www.nfhs.org.
141. NFPA - NFPA; (National Fire Protection Association); www.nfpa.org.
142. NFPA - NFPA International; (See NFPA).
143. NFRC - National Fenestration Rating Council; www.nfrc.org.
144. NHLA - National Hardwood Lumber Association; www.nhla.com.
145. NLGA - National Lumber Grades Authority; www.nlga.org.
146. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
147. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.

148. NRCA - National Roofing Contractors Association; www.nrca.net.
149. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
150. NSF - NSF International; (National Sanitation Foundation International); www.nsf.org.
151. NSPE - National Society of Professional Engineers; www.nspe.org.
152. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
153. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
154. NWFPA - National Wood Flooring Association; www.nwfa.org.
155. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
156. PDI - Plumbing & Drainage Institute; www.pdionline.org.
157. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; www.redwoodinspection.com.
161. SAE - SAE International; (Society of Automotive Engineers); www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association; www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
167. SIA - Security Industry Association; www.siaonline.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating and Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
178. STI - Steel Tank Institute; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; (Formerly: Tile Council of America); www.tileusa.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
184. TIA - Telecommunications Industry Association; (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
185. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
186. TMS - The Masonry Society; www.masonrysociety.org.
187. TPI - Truss Plate Institute; www.tpinst.org.
188. TPI - Turfgrass Producers International; www.turfgrasssod.org.
189. TRI - Tile Roofing Institute; www.tilerroofing.org.

190. UBC - Uniform Building Code; (See ICC).
191. UL - Underwriters Laboratories Inc.; www.ul.com.
192. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
193. USAV - USA Volleyball; www.usavolleyball.org.
194. USGBC - U.S. Green Building Council; www.usgbc.org.
195. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
196. WASTEC - Waste Equipment Technology Association; www.wastec.org.
197. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
198. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
199. WDMA - Window & Door Manufacturers Association; www.wdma.com.
200. WI - Woodwork Institute; (Formerly: WIC - Woodwork Institute of California); www.wicnet.org.
201. WMMPA - Wood Moulding & Millwork Producers Association; (See MMPA).
202. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
203. WPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up-to-date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; <http://dodssp.daps.dla.mil>.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; <http://eetd.lbl.gov>.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.

16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeia; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF - State of California; Department of Consumer Affairs; Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR - California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS - California Department of Health Services; (See CDPH).
4. CDPH - California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC - California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD - South Coast Air Quality Management District; www.aqmd.gov.
7. TFS - Texas Forest Service; Forest Resource Development and Sustainable Forestry; <http://txforests-service.tamu.edu>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. During construction, allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

1.4 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel. Refer to site utilization plan in Contract Documents as basis for locations.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
 - 1. Contractor shall provide a field office. The final location will be approved by the RCS prior to placement.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
- C. Temporary toilets: The high school facilities shall NOT be used by contractors. Temporary toilets must be set up for use. The final location will be approved by RCS prior to placement.
- D. Temporary space conditioning: Space conditioning shall be maintained in all spaces throughout the building for the duration of the project. The Contractor shall be responsible for any requirements to provide temporary space conditioning, if needed.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
 - 2. Maintain support facilities until near Substantial Completion of this Phase. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Roads and Paved Areas: Maintain existing roads and paved areas adequate for construction operations.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Coordinate with Owner regarding acceptable parking locations at each project site.

- E. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Contractor shall coordinate with Owner regarding access and security requirements at both project sites.

3.4 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor.
 - 2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or

indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 - 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 1. Construction layout.
 2. Field engineering and surveying.
 3. Installation of the Work.
 4. Cutting and patching.
 5. Progress cleaning.
 6. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
- B. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with

integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.

- G. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.5 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials

specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
- B. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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- B. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
- C. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017400 - WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
 - 1. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.
- B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS

- A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding; reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed

warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within 15 days of completion of that designated portion of the Work.

B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

C. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

1. Refer to Divisions 2 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

D. Form of Submittal: At Final Completion compile 2 copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

E. Bind warranties and bonds shall be submitted with the "Maintenance Manuals."

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.

2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.

3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 LIST OF WARRANTIES

- A. Schedule: Provide warranties on products and installations as specified in the individual sections of this specification.

END OF SECTION 017400

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Contractors must provide own dumpsters on-site. The RCS Chief Operations Officer must approve site locations for the dumpsters.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

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1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.3 ACTION SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
- C. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Clean exposed exterior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited access spaces, including roofs.
 - g. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 2. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.

- a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.

3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.

4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

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1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.

1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up Record Prints for each Project Site.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Electronic Media: CD.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings for each project site.
 - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.

- d. Locations and depths of underground utilities.
 - e. Changes made by Change Order or Construction Work Change Directive.
 - f. Changes made following Architect's written orders or Architect's Supplemental Instructions.
 - g. Details not on the original Contract Drawings.
3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2.2 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.

- e. Name of Contractor.
 - f. Date of video recording.
2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 4. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.

- j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

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- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

2

DIVISION

EXISTING CONDITIONS

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project Site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

- D. Hazardous Materials: There are hazardous materials in areas of demolition in the attic above the third floor..
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 4. Remove unsuitable materials and promptly dispose of off-site.
 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
 1. Remove existing where indicated and prep existing substrate for new work.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

3

DIVISION

CONCRETE

SECTION 03 10 00 – CONCRETE FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish, install, and remove all formwork for all cast-in-place concrete as shown or implied on the Contract Documents.
2. Design of formwork, shoring and reshoring.

B. Related Sections:

1. Division 03 Section: Concrete Reinforcement
2. Division 03 Section: Cast-in-Place Concrete

1.2 QUALITY ASSURANCE

A. Qualifications of Workmen:

1. Provide at least one person who shall be present at all times during execution of this portion of the Work.
2. This workman shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this work.
3. This workman shall direct all work performed under this Section.

B. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations and maintain tolerances contained in "Recommended Practice for Concrete Formwork," publication ACI 347-Latest Edition of the American Concrete Institute.
2. Where provisions of pertinent codes and standards conflict with the requirements of this Section of the Project Manual, the more stringent provisions shall govern.
3. Tolerance limits per ACI 117-Latest Edition.
 - a. Form concrete and set screeds or bulkheads so maximum variation in slab elevation in any bay does not exceed 1/2 inch.

C. Design:

1. Design of formwork, shoring and reshoring by a Professional Engineer of the State of Indiana.

1.3 PRODUCT HANDLING

A. Protection:

1. Use all means necessary to protect formwork materials before, during, and after installation and to protect the installed work and materials of all other trades.
2. Special precautions, as required to protect permanent steel forms and formwork for exposed concrete, shall be utilized after erection.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Form Lumber:

1. All form lumber in contact with exposed concrete shall be new or of sufficient quality to insure an unblemished texture.
2. All form lumber shall be one of the following or a combination thereof.
 - a. Plywood, board lumber, hardwood, or other material of grade or quality to best suit each particular usage.

B. Steel Forms:

1. Steel is an acceptable material for formwork.
2. Steel forms shall be "like new" producing a clean, smooth, unblemished texture for concrete exposed in the finished structure. Do not use damaged forms.

C. Form Release Agent: Provide non-staining and non-emulsifiable form release agent.

1. Standards:

- a. Release agent shall be similar to Magic Kote by Dayton Superior.
- b. Acceptable manufacturer: BASF Construction Chemicals, W.R. Meadows

D. Bracing/Shoring/Studs:

1. Such supports shall be selected for economy consistent with safety requirements and the quality required in the finished work. The Contractor is responsible for the design, illustration, safety, and serviceability of all formwork.

2.2 TIES/SPREADERS/ACCESSORIES

A. Type:

1. All form ties shall be a type which does not leave an open hole through the concrete and which permits neat and solid patching at every hole.

2. Spreaders shall be commercially manufactured devices compatible with the system.

B. Design:

1. When forms are removed, ties remaining within the concrete shall be not less than 1" from the surface.
2. Utilize ties with removable plastic cones where concrete will be exposed in the finished structure.

C. Wire Ties and Wood Spreaders:

1. Do not use wire ties and wood spreaders.

D. Other Materials:

1. All other materials not specifically described but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to advance acceptance by the Architect/Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to all work of this Section, carefully inspect the installed work of all trades and verify that all such work is complete to the point where form installation may properly commence.
2. Review the Contract Documents, including Addenda and Post Bid Revisions, as applicable, to determine all Contract requirements/details.
3. Verify that forms may be constructed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect/Engineer.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 CONSTRUCTION OF FORMS

A. General:

1. Construct all required forms to be substantial, sufficiently tight to prevent leakage of mortar.
2. The design and engineering of the formwork shall be the responsibility of the Contractor.

3. Formwork shall be designed for wet concrete and construction loads, lateral pressures, wind loads, and all other loads anticipated during construction.
4. Provide shoring and bracing as required to prevent undue deflection or bulging of concrete.
5. Provide removable sections at the base of forms, where required, to permit removal of debris, water, etc., from the formwork for walls and deep beams.

B. Layout:

1. Form for all required cast-in-place concrete to the shapes, sizes, lines and dimensions indicated on the drawings.
2. Exercise particular care in the layout of forms to ensure the proper finish structure size and shape.
3. Make proper provision for all openings, offsets, recesses, anchorage, blocking, and other features of the Work as shown or required.
4. Carefully examine the Contract Documents and consult with other trades as required to insure proper provisions for openings, reglets, chases, and other items in the forms.
5. Camber forms as required to allow for form deflections, slippage, and settlement of shores during concrete placement.

C. Embedded Items:

1. Set all required steel frames, angles, grilles, bolts, reglets, inserts, pipe, conduit, and other such items required to be anchored in the concrete before the concrete is placed.

D. Bracing and Shoring:

1. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to personnel.
2. Construct all bracing, supporting members, and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.
3. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.
4. All shoring shall extend to adequate foundations.
5. The Contractor is responsible for both the proper design and installation of all bracing and shoring, to properly ensure the safety and serviceability of the structure.

E. Tolerances:

1. Construct all forms straight, true, plumb, and square within the tolerances recommended by ACI 347.
2. Formed surfaces shall be Class A.
 - a. Abrupt irregularities in formed surfaces exposed to view in final construction shall not exceed 1/8 inch.
3. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

- a. Level Alignment: Variance in elevation of top of slab in any structural bay shall not exceed 1/2 inch.

F. Wetting:

1. Keep forms sufficiently wetted to prevent joints opening up before concrete is placed, except as recommended in ACI 306 R-78, "Recommended Practice for Cold Weather Concreting."

G. Construction Joints:

1. Refer to Division 03 Section: Cast-In-Place-Concrete of this Project Manual.

3.3 PLYWOOD FORMS

A. Assembly:

1. Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.

B. Joints:

1. Make all panel joints tight butt joints with all edges true and square.

3.4 FOOTING FORMS

A. Side Forms:

1. All footing sides shall be formed unless otherwise specifically authorized by the Architect/Engineer.

3.5 REUSE OF FORMS

A. Requirements:

1. Reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.
2. Reuse of forms shall in no way impart less structural stability to the forms, nor less acceptable appearance to finished concrete.

3.6 CLEAN-UP

A. General:

1. Before concrete is placed the forms shall be cleaned of all debris, ice, snow, frost, and standing water.

2. Remove all loose earth materials from the surfaces of earth forms.

3.7 REMOVAL OF FORMS

A. General:

1. Forms shall be removed in such manner to ensure complete safety of the structure.
2. Formwork for columns, walls, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations with the following minimums:
 - a. Formwork for walls and columns shall remain in place a minimum of two (2) days during which the temperature of the air surrounding the concrete must be above 50°F.
 - b. This minimum time period represents a cumulative number of days or fractions thereof.
 - c. Such formwork for concrete placed during cold weather with surrounding air temperatures below 50°F shall remain in place one day after the artificial heating and/or freeze protection is discontinued/ removed.
3. Forms and falsework supporting any vertical loads shall remain in place until the members have acquired sufficient strength to safely support their weight and any superimposed loads. Such forming shall remain in place until the concrete has attained its specified 28 day strength as indicated by the test cylinders unless reshores are installed in sufficient quantities to transmit the loads to adequate foundations without over stressing the partially cured structure. The requirements of ACI 305 and 306 must also be met before forms may be removed.
4. Forms for load bearing superstructure concrete shall never be removed earlier than seven (7) days after the concrete is placed.
5. Removal of forms and falsework is the responsibility of the Contractor, and the Contractor shall bear the full responsibility for this operation.
6. Concrete damaged by too early removal of forms or falsework shall be repaired or replaced as directed by the Architect/Engineer.
7. Concrete exposed by form removal during the curing period shall be cured by one of the methods specified in Division 03 Section: Cast-In-Place-Concrete.
8. Note that curing compound is not permitted in certain locations. In these cases, curing is to be by an alternate method. See Cast-in-Place Concrete specification for alternate methods.
9. In no case shall the superimposed load on relatively new concrete exceed 50 pounds per square foot unless proper shoring to suitable foundations is installed as required by the Architect/Engineer.
10. Methods and quantities of reshores shall be subject to the review/acceptance of the Architect/Engineer, but the responsibility for their adequacy shall remain with the Contractor.
11. Reshores shall extend to and bear on suitable foundation in all cases unless the Contractor submits calculations showing the acceptable dispersal of loads with reshores to lower floors that have attained their 28-day strength and the calculations are reviewed and accepted by the Architect/Engineer.

B. Removal

1. Use all means necessary to protect workmen, passers-by, the installed work and materials of other trades, and the complete safety of the structure.
2. Cut nails and similar fasteners off flush and leave all surfaces smooth and clean.
3. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.

END OF SECTION 03 10 00

SECTION 03 20 00 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish and install all bar supports, inserts, anchor bolts, welded wire fabric, reinforcing bars and all other items to be embedded in the cast-in-place concrete, not specifically indicated to be by others, as shown or implied on the Contract Documents.

B. Related Sections:

1. Division 03 Section: Concrete Formwork
2. Division 03 Section: Cast-in-Place Concrete
3. Division 03 Section: Epoxy Grout

1.2 QUALITY ASSURANCE

A. Qualifications of Workmen:

1. Provide at least one person who shall be present at all times during execution of this portion of the work.
2. This workman shall be thoroughly familiar with the type of materials being installed and the best methods for their installation.
3. This workman shall direct all work performed under this Section.

B. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures and ACI 318 - Building Code Requirements for Reinforced Concrete.
2. Where provisions of pertinent codes and standards conflict with this Section of the Project Manual, the more stringent provisions shall govern.

1.3 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings to the Architect/Engineer defining details of concrete reinforcement in accordance with Division 01 Section: Submittals of this Project Manual.
2. Reinforcing for concrete walls shall be shown on scale elevations of the walls as applicable.

3. The Contractor may release shop drawings for fabrication at his discretion; however, the Contractor shall bear all financial responsibility for changes to the shop drawings up to the time they are marked "Furnish as Submitted." Actual field installation shall only be made with shop drawings marked "Furnish as Submitted."
4. Where hooks are indicated on the Contract Drawings, provide standard hooks unless otherwise noted.
5. All accessories necessary for support of reinforcing steel shall be shown in plan. Do not schedule accessories.

B. Certifications:

1. Submit a certification that all material used is in accordance with the requirements of this Section.

1.4 PRODUCT HANDLING

A. Protection:

1. Use all means necessary to protect concrete reinforcement before, during, and after installation and to protect the installed work and materials of all other trades.
2. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond-breaking coatings.

B. Replacements:

1. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars and Dowels:

1. Conform to ASTM A615, Grade 60.

B. Welded Wire Fabric:

1. Conform to ASTM A1064, 6 x 6 x W 2.1x W 2.1, or as indicated on the drawings. Welded wire fabric shall be furnished in the flat sheet form in lieu of roll form.

C. Other Embedded Items:

1. Provide standard manufactured products as approved by the Architect/Engineer.

D. Bar Supports:

1. Conform to the requirements of the "Manual of Standard Practice," published by the Concrete Reinforcing Steel Institute.
2. Accessories shall be plastic protected Class "C" for all concrete exposed in the finished structure, except as specified below.
3. Accessories shall be Class "A," bright basic, for unexposed concrete.
4. Utilize Class "E," stainless steel bar supports, for exterior concrete to be finished by sand blasting.
5. Do not use continuous high chairs. Use individual high chairs laced with bottom cross bars plus #5 support bars. (Minimum of 2 rows of supports for all reinforcing.)
6. Supports must be capable of supporting construction loads without failing. Contractor to furnish additional supports at no cost to the Owner if in the Architect/Engineer's estimation the supports are not adequate.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to installation of the work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that concrete reinforcement may be installed in strict accordance with all pertinent codes and regulations and original design.

B. Discrepancies:

1. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

A. General:

1. Remove all dirt, oil, paint, loose rust, and other foreign materials from the concrete reinforcement prior to replacement.

3.3 PLACING

A. Reinforcing Bars:

1. Place reinforcing steel accurately in conformance with shop drawings stamped "Furnish as Submitted" by the Architect/Engineer.
2. Positively secure reinforcing to bar supports and tie or otherwise anchor bars to prevent displacement by construction loads or by the placing of concrete.

3. Splice bars with a minimum lap lengths indicated on the drawings. Use mechanical splicers/couplers where quantity of reinforcement restricts placement of concrete if lapped splices are utilized. Install mechanical splice as recommended by manufacturer.
4. Splice bars only at locations indicated on the Contract Documents and shop drawings.
5. Both shop and field bending shall be accomplished without heating the bars.
6. Minor placing adjustments can be made to avoid interference with other reinforcement and/or embedded devices. The final arrangement, however, is subject to review and acceptance of the Architect/Engineer.
7. Immediately notify the Architect/Engineer if reinforcing cannot be installed as detailed on the "Furnish as Submitted" shop drawings. No cutting of reinforcing should occur unless the Architect/Engineer has reviewed and allowed such cuts.

B. Embedded Devices:

1. Set hangers, anchor bolts, inserts, and other embedded devices accurately in place.
2. Make sure all such devices are installed so that work to be attached thereto will be properly received.
3. Keep devices straight and true-to-line.

C. Welded Wire Fabric:

1. Splice the welded wire fabric by lapping each section at least two meshes wide plus one wire with the adjacent section, but not less than 8".
2. Extend fabric into all openings, doorways, and the like, unless otherwise indicated.
3. Reinforce all equipment pads with 6x6-W2.1xW2.1 welded wire fabric unless otherwise indicated.
4. Support the welded wire fabric in slab-on-grade, with #4 continuous bars spaced at 2'-6" o.c. (maximum in one direction) and supported on concrete brick spaced at 2'-6" o.c.

3.4 CLEANING REINFORCING

A. Final Cleaning:

1. Prior to casting concrete, all loose mill and rust scale, oil, mud, ice, and other foreign coatings which destroy and/or reduce bond between the reinforcement and concrete shall be removed.
2. Wire brushing and/or other suitable methods shall be used to complete cleaning operations.

3.5 INSPECTION

A. Scheduling:

1. Notify the Architect/Engineer 24 hours in advance that forms and reinforcing are in place and are ready for inspection. Keep Architect/Engineer informed of the basic schedule so that he can anticipate inspection times in advance of the required 24-hour notice. Canceled pours are subject to additional inspection charges by the Architect/Engineer against the Contractor where the Architect/Engineer representative is already in route to

the site at the time the concrete pour is canceled. Inspection costs shall be based upon the hourly rate of the Architect/Engineer representative plus travel expenses.

2. Do not cast concrete until the Architect/Engineer has observed and accepted the installation.
3. Premature notification of the Architect/Engineer to inspect the reinforcement of forms shall be subject to additional inspection charges by the Architect/Engineer as described above.

END OF SECTION 03 20 00

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete as shown or implied by the Contract Documents.
2. Concrete requirements for housekeeping pads and inertial isolation slabs.

B. Related Sections:

1. Division 03 Section: Concrete Formwork
2. Division 03 Section: Concrete Reinforcement
3. Division 03 Section: Grouting
4. Divisions 21, 22, and 23 for housekeeping pads and inertial isolation slabs
5. Division 26 - Electrical, for housekeeping pads
6. Division 32 Section: Site Concrete, for exterior walls and slabs-on-grade

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. 116R – Cement and Concrete Terminology
2. 117 – Standard Specifications for Tolerances for Concrete Construction and Materials
3. 211.1 – Standard Practice For Selecting Proportions For Normal, Heavy Weight, And Mass Concrete
4. 214 – Recommended Practice For Evaluation Of Strength Test Results Of Concrete
5. 301 – Specifications for Structural Concrete
6. 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete
7. 305 R – Recommended Practice For Hot Weather Concreting
8. 306 R – Recommended Practice For Cold Weather Concreting
9. 318 – Building Code Requirements For Reinforced Concrete

B. ASTM International (ASTM):

1. C 33 – Standard Specification for Concrete Aggregates
2. C 94 – Standard Specification for Ready-Mixed Concrete
3. C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete
4. C 150 – Standard Specification for Portland Cement
5. C 260 – Standard Specification for Air-Entraining Admixtures for Concrete
6. C 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
7. C 494 – Standard Specification for Chemical Admixtures for Concrete

8. C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
9. D 6 – Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds
10. D 297 – Standard Test Methods for Rubber Products-Chemical Analysis
11. D 994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
12. D 1752 – Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
13. E 1155 – Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers
14. F609 – Standard Test Methods for static slip resistance of Footwear sole, heel, or related materials by horizontal-pull slipmeter.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturers literature for each type of product furnished.
- B. Shop Drawings:
 1. Provide layout drawings for coordination of floor slab pours. Indicate locations of expansion joints, construction joints, and control joints.
- C. Quality Assurance Submittals:
 1. Concrete Mix: Submit proposed concrete mix designs for each strength, slump, and combination of admixtures required for the Project.
 2. Test Reports:
 - a. Submit chloride ion tests or total chloride tests (with generally accepted method to relate total chloride to chloride ion) to show compliance with maximum ion concentrations.
 - 1) Tests may be from another job, utilizing the same proportions of aggregates, cements, and admixtures.
 - b. Submit slump, air-entrainment, compressive strength, and flatness and levelness test reports to the Architect/Engineer.

1.4 QUALITY ASSURANCE

- A. Codes and Standards:
 1. In addition to complying with all pertinent codes and regulations, comply with all pertinent requirements of the following American Concrete Institute Publications:
 - a. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials

- b. ACI 211.1 – Standard Practice For Selecting Proportions For Normal, Heavy Weight, And Mass Concrete
 - c. ACI 214 – Recommended Practice For Evaluation Of Strength Test Results Of Concrete
 - d. ACI 305 R – Recommended Practice For Hot Weather Concreting
 - e. ACI 306 R – Recommended Practice For Cold Weather Concreting
 - f. ACI 318 – Building Code Requirements For Reinforced Concrete
2. Where provisions of pertinent codes and standards conflict with this section of the Project Manual, the more stringent provisions shall govern.
- B. Qualification for Testing:
1. The following field-testing procedures shall be performed only by personnel holding current certificates issued by ACI for Concrete Field Testing Technician - Grade I as required by the local code.
 - a. Sampling of fresh concrete
 - b. Testing fresh concrete for slump
 - c. Testing fresh concrete for entrained air
 - d. Making concrete specimens for compression tests
 2. Flatness and levelness testing: Floor flatness and levelness testing shall be performed by a technician trained in the use of the testing equipment and the procedures of ASTM E 1155.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section: Project Management and Coordination. Review methods and procedures related to concrete Work, including, but not limited to, the following:
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review requirements for concrete tolerances, finishing, and curing methods, prior to commencing concrete work

1.5 PROJECT CONDITIONS

A. Environment Conditions:

1. Extreme temperature conditions:
 - a. When extreme hot or cold weather conditions occur, or are expected to occur, which might detrimentally affect concrete, employ handling and placing techniques to guard against such effects.
 - 1) Comply with the ACI nomograph.
 - b. Comply with the recommendations of American Concrete Institute publications ACI 305 R and ACI 306 R, for hot and cold weather concreting.

2. Inclement weather:
 - a. Unless adequate protection is provided, do not place exterior concrete during rain, sleet, or snow.
 - b. Do not use calcium chloride or admixtures containing soluble chlorides.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement: ASTM C 150, Type I or III
- B. Fine Aggregate: ASTM C 33 with fineness modulus, 2.40 to 3.00. For pumped concrete, 15 to 30% passing number 50 sieve and 5 to 10% passing a number 100 sieve.
- C. Coarse Aggregate:
 1. ASTM C 33 with maximum size:
 - a. Three-fourths of minimum clear spacing between reinforcing bars or between bars and forms
 2. Provide crushed stone for sidewalks, curbs, and exterior slabs/stairs
 3. Pea gravel shall not be used as an aggregate for any part of the elevated structure or the foundation system. Pea gravel may be acceptable for miscellaneous structural items ONLY as approved by the Architect/Engineer.
- D. Water: Clean, fresh, potable.
- E. Air-Entraining Admixture: ASTM C 260
- F. Concrete shall not exceed maximum chloride ion content for corrosion protection as defined in ACI 318 Table 4.4.1.
- G. Fly Ash: ASTM C 618, Class C or F.
 1. Fly ash shall not replace more than 20% of the cement.
- H. Curing and Sealing Compounds:
 1. Products: Furnish one of the following curing or curing and sealing compounds for each application listed:
 - a. Interior concrete slabs to receive floor coverings or other applied material: ASTM C 309, Type 1D, Class B; water based, all resin, dissipating, VOC compliant, clear with fugitive dye.
 - 1) Conspec Marketing & Manufacturing Co., Inc.; WB Resin Cure

- 2) Dayton Superior Chemical Division; Day-Chem Rez Cure (J-11-W)
 - 3) L&M Construction Chemicals, Inc.; Cure R
 - 4) W.R. Meadows; 1100 (Clear)
- b. Interior concrete slabs, finish scheduled as sealed concrete, or formed concrete requiring use of a curing compound: ASTM C 309, Type 1, Class B; water based, all resin, VOC compliant, clear.
- 1) Dayton Superior Chemical Division; Safe Cure & Seal (J-18)
 - 2) Euclid Chemical Company; Aqua-Cure VOX
 - 3) L&M Construction Chemicals, Inc.; Dress & Seal WB
 - 4) W.R. Meadows; Vocomp
 - 5) BASF Construction Chemicals; Sonneborn; Kure-N-Seal W
- c. Interior concrete slabs, finish scheduled as hardener/sealer or hardened sealed concrete: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
- 1) Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Intraseal.
 - 2) Curecrete Distribution Inc.; Ashford Formula.
 - 3) Dayton Superior Corporation; Day-Chem Sure Hard.
 - 4) Euclid Chemical Company (The); Euco Diamond Hard.
 - 5) L&M Construction Chemicals, Inc.; Seal Hard.
 - 6) Meadows, W. R., Inc.; Liqui-Hard.
 - 7) Symons Corporation, a Dayton Superior Company; Buff Hard.
- d. Product used shall be compatible with waterproofing if forms are stripped from concrete to receive waterproofing prior to 7 days curing above 50°F.
- e. Refer to Part 3 Article "Curing" for removal of curing compounds.
2. If curing compound is not used, and the forms are stripped prior to 7 days curing, the following methods are approved:
- a. Ponding or continuous sprinkling
 - b. Continuously wet mats
 - c. Sand kept continuously wet
- I. Expansion Strips:
1. Self-expanding cork: ASTM D 1752, Type III, preformed, self-expanding strips formed of cork particles with a non-bitumen, isolable resin binder for all interior and exterior slabs at building vertical faces, or as noted.
 2. Asphaltic board expansion joint: ASTM D 994, preformed joint material. Material shall not deform under normal handling, or become brittle. Use in exterior slabs, except at building vertical faces or as noted.
 3. Closed-cell poly

- J. Waterstops:
1. PVC flat ribbed waterstops:
 - a. Manufacturers:
 - 1) Vinylex Corporation
 - 2) Greenstreak.
 - b. Shapes and sizes to be reviewed by the Architect/Engineer.
 2. PVC dumbbell waterstops:
 - a. Manufacturers:
 - 1) Vinylex Corporation
 - 2) Greenstreak.
 - b. Shapes and sizes to be reviewed by the Architect/Engineer.
 3. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
 - 2) CETCO; Volclay Waterstop-RX.
 - 3) Concrete Sealants Inc.; Conseal CS-231.
 - 4) Greenstreak; Swellstop.
 - 5) Henry Company, Sealants Division; Hydro-Flex.
 - 6) JP Specialties, Inc.; Earth Shield Type 20.
 4. Additional types, shapes, and sizes to fit the job conditions, with review by Architect/Engineer.
 - a. Standard: Vinylex Corporation
- K. Joint Sealant:
1. Flatwork: Two-part polysulfide compound
 - a. Standard: "Euco Polysulphide sealant" by the Euclid Chemical Company
 2. Vertical joints: Two-part polysulfide compound
 - a. Standard: W.R. Meadows CM-60
 3. Vertical joints: Two-part polyurethane, refer to Section 07920.
- L. Water Reducing Admixtures:

1. Normal set: ASTM C 494, Type A
 2. Retarders: ASTM C 494, Type D
 3. Accelerators: ASTM C 494, Type C or E
 4. High range water reducers: ASTM C 494, Type F
- M. Crystalline Waterproofing Additive: Concrete waterproofing and protection system shall be of the crystalline type provided in a carrier of cement and sand.
1. Testing Requirements: Crystalline waterproofing system shall be tested in accordance with the following standards and conditions. Testing shall be performed by an independent laboratory.
 2. Crystalline Formation: Crystallizing capability of waterproofing system shall be evidenced by independent SEM (Scanning Electron Microscope) photographs showing crystalline formations within the concrete matrix at a magnification no greater than 2000 times.
 3. Permeability: Independent testing shall be performed according to U.S. Army Corps of Engineers CRD-C48 - Mod "Permeability of Concrete" on maximum 2" thick samples. **The treated samples shall exhibit no measurable leakage against control samples which shall exhibit full saturation and measurable leakage.** Treated samples shall have an over 95% reduction in permeability.
 4. Crack Healing: Crack healing testing shall have been performed where cracks in the treated panels shall heal within several days and cracks in the non-treated panels shall be shown to continue to pass water at the completion of the 2.5 week test.
 5. Acceptable products:
 - a. Kryton international Inc.: Krystol Internal; Krystol Internal Membrane for Concrete.
 - b. Xypex Chemical Corporation.; Xypex Admixture
 6. Doseage rate: Crystalline dosage as recommended by manufacturer; no less than 2%-3% by weight of cement content.
- N. Evaporation Retardant:
1. Standard: Master Builders Confilm; Degussa Building Systems
 2. Apply per manufacturer's directions.
- O. Bond Break:
1. 15 pound per square (100 sq.ft.) building paper
- P. Bonding Agent:
1. Select bonding agent to suite the job condition and application.
 2. Products:
 - a. Conpro Primer by Conproco Corp.

- b. SBR Latex by the Euclid Chemical Company.
 - c. Everweld by L&M Construction Chemicals Inc.
3. Apply per manufacturer recommendations.
 4. Finished concrete surface shall be roughened and cleaned, prior to application of the bonding agent.

2.2 MIX DESIGNS

A. Normal Weight Concrete:

1. Compressive strength: 4000 PSI.
2. Minimum cement content: 517 pounds per cubic yard (adjust for air entrainment).
3. Water/cement ratio: 0.45 maximum (Typical) 0.40 for concrete exposed to deicing salts, blackish water or salt spray, no water to be added to concrete after plant batching.
4. Slump: 4" + 1", adjust with addition of the admixture for pumping.
5. Typical for slabs unless walls, beams, columns and footing noted otherwise.

B. Air-Entrainment:

1. Provide air entrainment at:
 - a. All concrete that is to be exposed to the elements (weather) in the completed structure.
 - b. All concrete in contact with salts.
2. All other concrete may be air-entrained or non-air-entrained, at the Contractor's option.
 - a. Hard-troweled finishes shall not have air-entrainment.
3. Percentage of air content shall be determined in accordance with the admixture manufacturer's recommendations, to meet ASTM C173 or ASTM C231, based on aggregate size and a moderate level of exposure.

C. Selection of Concrete Proportions:

1. Proportions of materials for concrete shall be established in accordance with Section 5.2 of ACI 318.
2. Follow ACI 211 and ACI 301 to determine the water-cement ratio for lightweight concrete.
3. Concrete Mixing:
 - a. Plant mix concrete materials in same proportions as approved concrete mix design in accordance with ACI 304.
 - 1) Incorporate admixtures in quantities and using methods recommended by admixture manufacturers.
 - 2) Incorporate only admixtures included in the approved mix design, or with approval by Architect/Engineer.

- b. Do not add water to batched concrete without approval by Architect/Engineer.

D. High Slump Concrete:

1. Slumps greater than those specified may be used (up to 10") under the following conditions:
 - a. Prior approval has been obtained from the Architect/Engineer, including location of pours and proposed mixes.
 - b. Admixture systems or high range water reducers are used to achieve the high slumps.
 - c. Water-cement ratios are compatible with normal mixes.
 - d. Compressive strength of the concrete exceeds normal mixes at specified slumps.
 - e. If high range water reducers are used, the admixture is added by a concrete technician employed by the concrete supplier.
2. Submit mix designs to Architect/Engineer for review.
3. This review is made to ensure that portions of the mix meet the specifications. All performance related criteria must still be met.

E. Crystalline Waterproofing:

1. Add crystalline waterproofing admixture at a rate of 2-3 percent by weight of portland cement content.
2. Provide in concrete where “integral crystalline waterproofing” or “integral waterproofing” is indicated.

PART 3 - EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

A. Inspection:

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that all items to be embedded in concrete are in place.
3. Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.

B. Discrepancies:

1. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

- A. Remove all wood scraps, ice, snow, frost, standing water, and debris from the area in which concrete will be placed.
- B. Thoroughly wet the surface of excavations (except in freezing weather), coat forms with release agent, and remove all standing water.
- C. Thoroughly clean all transporting and handling equipment.
- D. All concrete slabs on grade to be placed on a granular fill. Depth of fill to equal the slab thickness unless otherwise noted.

3.3 CONCRETE MIXING

- A. Plant mix concrete materials in same proportions as approved concrete mix design and in accordance with ACI 304.
 - 1. Incorporate admixtures in quantities and using methods recommended by admixture manufacturers.
 - 2. Incorporate only admixtures included in the approved mix design, or with approval by Architect/Engineer.
- B. Do not add water to batched concrete without approval by Architect/Engineer.

3.4 PLACING CONCRETE

- A. Method:
 - 1. Convey concrete from mixer to place of final deposit by methods that will prevent separation and loss of materials.
 - 2. For chuting, pumping, and pneumatically conveying concrete, use only equipment of such size and design as to ensure a practically continuous flow of concrete at the delivery end without loss or separation of materials.
 - 3. Deposit concrete as nearly as possible in its final position to avoid segregation due to re-handling and flowing.
 - 4. Contractor shall use screed poles or similar devices to ensure that all slabs are cast at the proper elevations and that specified tolerances are maintained.
 - 5. Deflections of supporting structure are to be anticipated to produce a level slab.
- B. Rate of Placement:
 - 1. Place concrete at such a rate that concrete is at all times plastic and flows readily between reinforcement.
 - 2. When placing is once started, carry it on as a continuous operation until placement of the panel or section is complete.
 - 3. Do not pour a greater area at one time than can be properly finished; this is particularly important during hot or dry weather.

C. Compaction:

1. Thoroughly consolidate all concrete by suitable means during placement, working it around all embedded fixtures and into corners of forms.
2. During placement, thoroughly compact the concrete by hand tamping and by mechanical vibration.

D. Acceptability:

1. Do not use retempered concrete or concrete that has been contaminated by foreign materials.

E. Limits of Pour:

1. No concrete pour of normal weight concrete shall exceed the following limits in any direction without prior approval of the Architect/Engineer:
 - a. Length to width ratio: 2
2. Minimum time period between adjacent pours shall be 24 hours.

3.5 LEVELING AND FINISHING

A. General: Finish concrete in accordance with ACI 301.

B. Finishing Exposed Walls:

1. Remove fins and fill tie holes, honeycombs and air holes (bug holes).
2. Provide a rubbed finish on all interior exposed concrete walls.
3. Provide a smooth rubbed finish on all exposed exterior concrete walls, including site walls.
4. Finishing methods:
 - a. Rubbed finish:
 - 1) Not later than one day after form removal, rub with carborundum brick or another abrasive to remove fins, ridges and other surface irregularities.
 - b. Smooth rubbed finish:
 - 1) Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

C. Finishing Slabs, Flatwork, Walk, Stairs:

1. Trowel all interior slabs to a smooth, hard finish unless otherwise indicated.
 - a. Provide a non-slip finish in all areas subject to public traffic.

2. Surfaces to receive a light broom finish:
 - a. Exterior slabs, walks, stairs
 - b. Interior floors to receive a dry set mortar installation of ceramic tile, tile, or pavers.
 - c. Interior stair treads not scheduled to receive floor covering
3. Where floor drains or floor slopes are indicated, slope slabs uniformly to provide even fall for drainage.

D. Tolerances:

1. Place concrete so members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
 - a. Level Alignment: Variance in elevation of top of slab in any typical structural bay shall not exceed 1/2 inch.
2. Floor slabs: Finish floor slabs to meet the following flatness and levelness test requirements.
3. Definitions:
 - a. Test surface: The entire floor area on any one building level.
 - b. Test Section: Any subdivision of the test surface measuring no less than 8 feet on a side and no less than 320 square feet.
4. Test Sections less than 8 feet on a side or less than 320 square feet or at slab boundaries, block-outs or other discontinuities excluded by ASTM E 1155: Finish and measure surface so gap at any point between concrete surface and an unlevelled freestanding 10-foot- (3.05-m-) long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed 1/4 inch.
 - a. Finish interior slab surfaces to the following tolerances, measured with a Type II apparatus within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface. Submit report to the Architect/Engineer within 72 hours of concrete placement.
 - 1) Specified overall values of flatness, F_F 30; and levelness, F_L 20; with minimum local values of flatness, F_F 24; and levelness, F_L 15.

3.6 JOINTS

A. Expansion Joints:

1. Provide where indicated on the Contract Documents.
2. Install expansion strips full depth of joints.
3. Where caulking of joints is indicated on Drawings, install fillers to 1/2 inch of top and pour full with sealant.

- a. Standard: See "Joint Sealant for Flatwork," this section.
 4. Provide self-expanding cork at all intersections of exterior concrete and vertical surfaces. Caulk top 1/2 inch of joint.
 5. Where asphalt expansion joints are not sealed hold top of asphalt 1/4 inch below abutting concrete. Tool joints on both sides of expansion joint.
- B. Tooled Joints:
1. Provide standard tooled joints where indicated on the Contract Documents.
 2. Make joints straight, clean, and unragged.
 3. Tool concrete on both sides of asphalt pavement.
- C. Construction Joints:
1. Joints shall be made with properly constructed bulkheads and include formed keyways.
 2. Reinforcing shall extend through all construction joints unless otherwise noted on the Contract Documents.
 3. The Contractor shall consult with the Architect/Engineer before starting concrete work to establish a satisfactory placing schedule and to determine the location of construction joints so as to minimize the effects on the floor systems.
 4. Horizontal construction joints, other than where shown on the Contract Documents, will not be permitted.
 5. Vertical construction joints shall be located between quarter and third points of the spans. Submit construction joint layout for A/E review and approval.
- D. Bond Break:
1. Install where indicated. Lap seams a minimum of 4 inches.
- E. Waterstops:
1. Install where indicated.
 2. Vinyl waterstop joints shall be chemically or heat welded per manufacturer's recommendations.
 - a. Install waterstop near center of concrete pour, unless otherwise indicated on Drawings.
 3. Bentonite waterstops shall be installed in accordance with manufacturer's instructions.
 - a. Provide 3 inches minimum concrete cover.

3.7 CURING

A. Formed Surfaces:

1. Cure formed surfaces by either of the following methods:

- a. Refer to Division 03 Section "Formwork" for minimum time periods that formwork must remain in place even when curing compound is used.
- b. Leave forms in place until the cumulative number of days or fractions thereof, not necessarily consecutive, has totaled seven days during which the temperature of the air in contact with the concrete is 50°F or above.
- c. Remove forms at an earlier time but apply curing compound to concrete surfaces.
- d. Apply compound in accordance with manufacturer's recommendations.
- e. Do not add curing/sealing compound to walls that receive waterproofing unless a letter has been submitted to the Architect/Engineer, prior to the compound's use, that the specific compounds are compatible with their system.

B. Troweled Finish:

1. As soon as surface has dried sufficiently to not be marred by the application, apply sealer/curing compound in accordance with manufacturer's recommendations.
2. Do not add curing/sealing compound to walls that receive waterproofing unless a letter has been submitted to Architect/Engineer, prior to the compound's use, that the specific compounds are compatible with their system.
3. After application, keep all traffic, tools, materials, and equipment off such treated areas for at least twenty-four hours.
4. For floors scheduled as sealed concrete, after all other work in the area has been completed, apply a second coat of sealer/curing compound.

C. Wet Cure:

1. Concrete not covered with curing compound should be kept wet for at least 7 days.
2. Keep forms continuously wet to prevent the moisture loss until forms are removed.

D. Curing Compound Removal:

1. Remove residual curing compound from floor slabs to receive applied finishes using methods recommended by the manufacturer of the curing compound.
2. Remove curing compound no earlier than 28 days after application or after structure is enclosed and protected from exterior water sources.
3. Wet mop or rinse and wet vacuum slab to remove traces of cleaning products.

E. Hardener/Sealer:

1. Apply to wet-cured concrete in accordance with manufacturer's instructions.

3.8 PATCHING AND REPAIR

A. Inspection/Remedial Work:

1. Immediately after forms and curing membranes have been removed, inspect all concrete surfaces and patch all pour joints, voids, rock pockets, form tie holds, and other imperfections before the concrete is thoroughly dry.

B. Patching and Minor Repairs:

1. At all permanently exposed portion of interior concrete formed surfaces, repair surface defects including color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface.
 - a. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth.
 - 1) Make edges of cuts perpendicular to concrete surface.
 - b. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - c. Fill and compact with patching mortar before bonding agent has dried.
 - d. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete durability and structural performance as determined by Architect/Engineer.
 4. Remove all fins, offsets and projections by dry-stoning surfaces which will be exposed in the finished structure or will receive waterproofing or other barrier coating or membrane.
 - a. Provide additional patching of foundation wall for application of waterproofing membrane, in accordance with the manufacturer's recommendations.
 5. Remove or fill all ridges, trowel marks, protrusions or pits more than 1/8-inch diameter on floor slabs by dry-stoning, grinding, or filling with trowelable cementitious underlayment.
- C. Patching of Existing Concrete:
1. Patch in manner to receive new finishes so that existing and patched surfaces are smooth and continuous and have a uniform appearance, using methods specified for patching and repair.
- D. Major Defective Areas:
1. If the defects are serious or affect the strength of the structure, or if patching does not satisfactorily restore the quality and appearance of the surface, the Architect/Engineer may require the concrete to be removed and replaced complete in accordance with the provisions of this Section, all at no additional cost to the Owner.
 2. Floor slabs that do not meet tolerances specified shall be remediated by the Contractor to the elevation, flatness, or levelness specified at no additional cost to the Owner.

- a. Contractor shall use floor-leveling materials acceptable to the manufacturer of floor finishes scheduled for the area to be remediated.

3.9 TESTS

A. Testing Laboratory:

1. The owner shall engage the testing agency to conduct the testing for compliance with the requirements of the Project Manual.

B. Compression Tests:

1. Secure minimum five standard cylinders from each pour of concrete, additional five sets of cylinders for every 50 cubic yards of concrete placement of the day, in accordance with ASTM C31, and cure under standard moisture and temperature conditions.
2. From each batch test in accordance with ASTM C39.
3. Test two cylinders at 7 days and two cylinders at 28 days, and save one for additional test, if needed.
4. Submit duplicate tests reports of results from testing to Architect/Engineer.
5. Take steps immediately to evaluate unsatisfactory test results. Test the fifth cylinder.
6. In the event of unsatisfactory test results, an investigation as outlined in Section 5.6.4 of ACI 318-Latest Edition shall be employed.

C. Slump/Air-Entrainment:

1. Perform slump tests in accordance with ASTM C 143.
2. Determine the air content of air-entrained concrete in accordance with ASTM standards.
3. Report results of slump tests on each compression test report, and report whether the concrete represented by the compression tests is air-entrained or nonair-entrained.

D. Floor Profile:

1. Test floor profile in accordance with ASTM E 1155 within 24 hours of floor placement, before shoring is removed.
2. Submit test results to Architect/Engineer within 72 hours of concrete placement.

E. Retesting:

1. Should additional testing be required because of unsatisfactory tests results, the Contractor shall reimburse the owner for the costs incurred for correcting any deficiencies and the costs of any tests.

END OF SECTION 03 30 00

SECTION 03 60 00 — EPOXY GROUT

PART I - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish labor and materials to install epoxy grout as shown or implied by the Contract Documents.
2. Furnish labor and materials necessary to grout anchor bolts and reinforcing bars into existing concrete and to patch existing concrete at equipment anchorages.
3. Furnish labor and materials to patch and repair existing concrete.
4. Furnish labor and materials to repair new construction as required by field errors or omissions.

B. Related Sections:

1. Division 03 Section: Concrete Formwork
2. Division 03 Section: Concrete Reinforcement
3. Division 03 Section: Grouting
4. Division 05 Section: Structural Steel Framing

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. Repairing concrete with epoxy grout and epoxy mortars shall conform to all requirements of Standard Specification for Repairing Concrete with Epoxy Mortars (ACI 503.4-Latest Edition), publishing by the American Concrete Institute, Detroit Michigan, except as modified by the requirements of this project specification.

1.3 SUBMITTALS

- ##### A.
- Before any of the materials of this Section are delivered to the job site, submit product literature to the Architect/ Engineer in accordance with Division 01 Section: Submittal Procedures of these Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- ##### A. Reference Standard:
- Provide products manufactured by the following:

1. Sika Corporation

2.2 PRODUCTS

- A. Epoxy Grout for Grouting Anchor Bolts or Concrete Patching Mortar (when mixed with recommended aggregate):

1. For overhead installations:

- a. Sika Corporation; Sikadur 35, Hi-Mod LV
- b. Simpson Strong-Tie Company, Inc.; FX-763
- c. BASF Corporation Building Systems; MasterEmaco ADH 327RS

2. For non-overhead installations:

- a. Laticrete International, Inc.; Spectralock Pro
- b. Laticrete International, Inc.; Spectralock 2000 IG
- c. Sika Corporation; Sikadur 31 Hi-Mod Gel

3. Adhesive anchors:

- 1) HIT-RE 500 V3; Hilti Inc.
- 2) HIT-HY 200; Hilti, Inc.
- 3) HIT-HY 70; Hilti, Inc.
- 4) Epcon System; ITW Red Head
- 5) Pure 110+; Powers Fasteners, Inc.

4. Due to the large number of different applications and field conditions, additional products may be required by the Architect/Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Surface Preparation:

1. Surfaces of existing concrete shall be dry and structurally sound prior to grouting.
2. The surfaces of concrete at the perimeter of openings, which will be in contact with the grout fill, shall be cleaned. Remove dirt, oil, grease, and other foreign matter.
3. Apply cleaning agent, lacquer thinner by means which will not allow spillage and dripping on existing facilities below.
4. Existing steel reinforcing shall be cleaned by wire brush or by sand blasting, or needle gun, with all loose or damaged material removed.

3.2 INSTALLATION

A. Preparation:

1. Form to lines and elevations indicated or required such that adequate anchorage and bearing is provided.

B. Application:

1. Apply grout in accordance with the manufacturer's recommendations. Thoroughly pack forms to minimize shrinkage.
2. Rodding may be required to eliminate voids, honeycombing, and similar defects. Consult manufacturer.
3. Finished installation shall be tight, neat, smooth, and flush with adjoining surfaces and shall be thoroughly bonded thereto.
4. Loose, spalled, cracked, or otherwise defective material will be rejected.
5. Application by trowel is acceptable when forming is impractical or impossible.
6. Notify engineer of proposed method of installation prior to commencement of work.
7. When repairing existing concrete, restore original concrete size and shape with new material.
8. Avoid feathered edges by undercutting edges at sides of patches.
9. Notify engineer of any crack suspected of being a "working joint" prior to patching.

C. Curing:

1. Protect and cure grout in accordance with the manufacturer's recommendations.

END OF SECTION 03 60 00

SECTION 03 60 01 – GROUTING

PART I - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish and install all grout as indicated or implied by the Contract Documents.

B. Related Sections:

1. Division 03 Section: Cast-in-Place Concrete
2. Division 05 Section: Structural Steel Framing
3. Division 05 Section: Metal Fabrications

1.2 DELIVERY AND STORAGE

- A. Prevent damage to or contamination of non-shrink grouting materials during delivery, handling, and storage.
- B. Store all non-shrink grouting materials in undamaged condition with package labels and seals intact.

1.3 SUBMITTALS

A. Product Literature:

1. Submit sufficient data regarding installation methods and compression strength.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metallic Non-Shrink Non-Catalyzed Mortar: ASTM C1107

1. Reference Standard: BASF Corporation Building Systems; MasterFlow 885
2. General use: precision grouting of equipment.
3. All grout subject to fatigue

B. Non-Metallic Non-Shrink Cementitious Grout: ASTM C1107

1. Reference Standard: BASF Corporation Building Systems; MasterFlow 713

2. General use: Precision grouting of structure or building systems.
3. If grout is subject to fatigue, use metallic grout.

C. Latex Modified Concrete: ASTM C1059

1. Standard: Latex.
 - a. Acrylic Additive: BASF Construction Chemicals, LLC: Thoro Acryl 60
 - b. Standard: Concrete.
 - c. Per Cast-in-Place Concrete section of this Specification
2. General use: Patching large holes and areas
3. Submit mix design.

D. Pre-Mixed Repair Mortar or Gel:

1. Vertical and horizontal surfaces:
 - a. Sika Corporation; Sikatop 122 Plus
2. Overhead surfaces:
 - a. Sika Corporation; Sikatop 123 Plus
3. General use: Fill large cracks and reform lines of beams, columns, or walls in areas too small to form.

E. Portland Cement:

1. ASTM C150, Type I or III

F. Sand:

1. ASTM C33, fine aggregate

G. Water:

1. Potable

2.2 MIXES

- A. Follow manufacturer's recommendations for grout mixing.
- B. Use minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding.

2.3 MIXING

- A. Mix non-shrink grout materials in water in a mechanical mixer for no less than 5 minutes.
- B. Do not retemper grout or add more water for any reason.

PART 3 - EXECUTION

3.1 INSTALLATIONS

- A. Thoroughly clean all surfaces with which grout will be in contact free from dirt, grease, rust, and other deleterious substances. Form to lines and elevations indicated or required such that adequate bearing for structural elements is provided.
- B. Apply non-shrink grout immediately after mixing. Thoroughly pack forms to minimize shrinkage. Rodding is required to eliminate all voids, honeycombing and similar defects. Cure grout as recommended by manufacturer. Finished installation shall be tight, neat, smooth, and flush with adjoining surfaces and shall be thoroughly bonded thereto. Loose, spalled, cracked, or otherwise defective material will be rejected.

3.2 SURFACE PREPARATION

- A. Remove all defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces. Clean all steel surfaces.
- B. Lightly roughen concrete surfaces.
- C. Align, level, and maintain final positioning of all components.
- D. Saturate all concrete surfaces with clean water, remove excess water. Leave no standing water.
- E. Take special precautions during extreme weather conditions according to manufacturer's written instructions.

3.3 PLACING GROUT

- A. Select material in accordance with manufacturer's recommendation.
- B. Place non-shrink grouting material quickly and continuously.
- C. Apply grout from one side only to avoid air pockets.
- D. If shims are used, do not remove for at least 48 hours after grout has been placed. After removal of shims, fill voids with plain cement-sand grout.

3.4 PLACEMENT OF LATEX MODIFIED CONCRETE

- A. Chip substrate as required to expose fresh clean material.
- B. Chip edges of voids so as not to produce feathered edges.
- C. Mix per submitted mix design with clean uncontaminated containers and tools. Thoroughly mix material. Place and vibrate as required to produce uniform void-free mix.
- D. Protect uncured material from detrimental environmental conditions.

3.5 PLACEMENT OF PREMIXED REPAIR MORTAR OR GEL

- A. Mix per manufacturer's instructions.
- B. Chip substrate as required to expose fresh clean material.
- C. Chip edges of voids so as to not produce feathered edges.
- D. Install per manufacturer's instructions.

3.6 CURING

- A. Cure grout for 3 days after placing by keeping work wet and covered.

END OF SECTION 03 60 01

4

DIVISION

MASONRY

SECTION 04 05 16 – ENGINEERED MASONRY GROUTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this Section.
- B. Requirements of Section 04 22 00 "Concrete Unit Masonry" apply to work of this Section.

1.2 SUMMARY

- A. Extent of each type of reinforced unit masonry work is indicated on Drawings and in schedules.

1.3 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcement bars.
 - 1. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures."
 - 2. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Reinforcement Bars: deformed bars of following grades complying with ASTM A 615, except as otherwise indicated
 - 1. Provide Grade 60 for bars No. 3 to No. 18, except as otherwise indicated.
 - 2. Shop fabricate reinforcement bars which are shown to be bent or hooked.

PART 3 - EXECUTION

3.1 PLACING REINFORCEMENT

- A. General:
 - 1. Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout.
 - 2. Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
- B. Position reinforcement accurately at the spacing indicated.
 - 1. Support and secure vertical bars against displacement.
 - 2. Horizontal reinforcement may be placed as the masonry work progresses.
 - 3. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1 inch, whichever is greater.
- C. Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Architect/Engineer.
 - 1. Provide lapped splices, unless otherwise indicated.
 - 2. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.
- D. Provide not less than minimum lap indicated, or if not indicated, as required by governing code.
- E. Anchoring: Anchor reinforced masonry work to supporting structure as indicated.

3.2 MASONRY INSTALLATION, GENERAL:

- A. Refer to Section 04 22 00 "Concrete Unit Masonry" Sections for general installation requirements of unit masonry.

3.3 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. General:

1. Do not wet concrete masonry units (CMU).
2. Lay CMU units with full-face shell mortar beds.
3. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar.
4. Maintain head and bed joint widths shown, or if not shown, provide 3/8 inch joints.

B. Walls:

1. Pattern Bond: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated.
2. Bond and interlock each course at corners and intersections.
3. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.
4. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars.
 - a. Keep cavities free of mortar.
 - b. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
5. Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars.
 - a. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

C. Grouting:

1. Use ASTM C 476 "Fine Grout" for filling spaces less than 4 inches in one or both horizontal directions.
2. Use ASTM C 476 "Coarse Grout" for filling 4 inch spaces or larger in both horizontal directions.
3. Grouting Technique: At the Contractor's option, use either low-lift or high-lift grouting techniques, in accordance with specified requirements.

D. Low-Lift Grouting:

1. Provide minimum clear dimension of 2 inches and clear area of 8 square inches in vertical cores to be grouted.
2. Place vertical reinforcement prior to laying of CMU.
 - a. Extend above elevation of maximum pour height as required for splicing.
 - b. Support in position at vertical intervals not exceeding 192 bar diameters nor 10 ft.
3. Lay CMU to maximum pour height. Do not exceed 5 feet height, or if bond beam occurs below 5 feet height, stop pour at course below bond beam.
4. Pour grout using chute or container with spout.

5. Rod or vibrate grout during placing.
 6. Place grout continuously; do not interrupt pouring of grout for more than one hour.
 7. Terminate grout pours 1-1/2 inches below top course of pour.
 8. Bond Beams: Stop grout in vertical cells 1-1/2 inches below bond beam course.
 - a. Place horizontal reinforcement in bond beams; lap at corners and intersections as indicated or required by Code.
 - b. Place grout in bond beam course before filling vertical cores above bond beam.
- E. High-Lift Grouting:
1. Do not use high-lift grouting technique for grouting of CMU unless minimum cavity dimension and area is 3 inches and 10 square inches, respectively.
 2. Provide cleanout holes in first course at all vertical cells which are to be filled with grout.
 3. Use units with one face shell removed and provide temporary supports for units above, or use header units with concrete brick supports, or cut openings in one face shell.
 4. Construct masonry to full height of maximum grout pour specified, prior to placing grout.
 5. For single wythe hollow concrete masonry walls, limit grout lifts to a maximum height of 5 feet and grout pour to a maximum height of 24 feet, unless otherwise indicated.
 6. Place vertical reinforcement before grouting.
 - a. Place before or after laying masonry units, as required by project conditions.
 - b. Tie vertical reinforcement to dowels at base of masonry where shown and thread CMU over or around reinforcement.
 - c. Support vertical reinforcement at intervals not exceeding 192 bar diameters nor 10 feet.
 7. Where individual bars are placed after laying masonry, place wire loops extending into cells as masonry is laid and loosen before mortar sets.
 - a. After insertion of reinforcement bar, pull loops and bar to proper position and tie free ends.
 8. Where reinforcement is prefabricated into cage units before placing, fabricate units with vertical reinforcement bars and lateral ties of the size and spacing indicated.
 9. Place horizontal beam reinforcement as the masonry units are laid.
 10. Embed lateral tie reinforcement in mortar joints where indicated. Place as masonry units are laid, at vertical spacing shown.
 11. Where lateral ties are shown in contact with vertical reinforcement bars, embed additional lateral tie reinforcement in mortar joints.
 - a. Place as shown, or if not shown, provide as required to prevent grout blowout or rupture of CMU face shells, but provide not less than No. 2 bars or 8-gage wire ties spaced 16 inches o.c. for members with 20 inches or less side dimensions, and 8 inches o.c. for members with side dimensions exceeding 20 inches.
 12. Preparation of Grout Spaces:
 - a. Prior to grouting, inspect and clean grout spaces.
 - b. Remove dust, dirt, mortar droppings, loose pieces of masonry and other foreign materials from grout spaces.
 - c. Clean reinforcement and adjust to proper position.
 - d. Clean top surface of structural members supporting masonry to ensure bond.

- e. After final cleaning and inspection, close cleanout holes and brace closures to resist grout pressures.
13. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist displacement of masonry units and breaking of mortar bond.
 - a. Install shores and bracing, if required, before starting grouting operations.
 14. Place grout by pumping into grout spaces unless alternate methods are acceptable to the Architect/Engineer.
 15. Limit grout pours to sections which can be completed in one working day with not more than one hour interruption of pouring operation.
 - a. Allow not less than 30 minutes, nor more than one hour between lifts of a given pour.
 - b. Rod or vibrate each grout lift during pouring operation.
 16. Where bond beam occurs more than one course below top of pour, fill bond beam course to within 1 inch of vertically reinforced cavities, during construction of masonry.
 17. When more than one pour is required to complete a given section of masonry, extend reinforcement beyond masonry as required for splicing.
 - a. Pour grout to within 1-1/2 inches of top course of first pour.
 - b. After grouted masonry is cured, lay masonry units and place reinforcement for second pour section before grouting.
 - c. Repeat sequence if more pours are required.

END OF SECTION

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes masonry veneer assemblies consisting of the following:
 - 1. Brick veneer repair and infill
 - 2. Embedded flashing and weeps.
 - 3. Cavity-wall insulation.
- B. Refer to Section 042200 – “Concrete Unit Masonry” for load bearing and non-load bearing concrete masonry units, reinforcement, anchorage and steel lintels.

1.2 PERFORMANCE REQUIREMENTS

- A. Masonry work shall comply with requirements ACI 530.1/ASCE6/TMS 602.
- B. Brick veneer infill and repair work shall follow Brick Institute of America (BIA) guidelines and recommendations.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
 - 1. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection: For the following:
 - 1. Face brick, in the form of straps of five or more bricks.
 - 2. Colored mortar.
- D. Samples for Verification: For each type and color of the following:
 - 1. Face Brick
 - 2. Stone trim.
 - 3. Weep holes/vents.
 - 4. Accessories embedded in masonry.
- E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.4 QUALITY ASSURANCE

- A. Brick and stone veneer units shall match existing at each project site. Provide color, shape, and quality to match existing materials.

- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects.
 - 1. Build mockups of brick veneer and stone trim and details where indicated on the Drawings. If not indicated constructed mock up locations shall be selected by the Architect and if acceptable, may remain part of the finished work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 BRICK

- A. Face Brick: ASTM C 216, Grade SW, Type FBS.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.
 2. Size, color, texture: Where it is not possible to utilize salvage brick from demolished portions of the building provide new brick veneer for new work. Match existing brick veneer in the locations where new infill or repair work is required

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- B. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
- a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
 - b. Davis Colors; True Tone Mortar Colors.
 - c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.
- C. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
- D. Water: Potable.

2.5 TIES AND ANCHORS

- A. Materials: Provide ties and anchors as specified below, unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82; with ASTM A 153/A 153M, Class B-2 coating.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

2.6 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing: For flashing not exposed to the exterior, use[one of] the following, unless otherwise indicated:
 - 1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:
 - a. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch- thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.
 - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Weep/Vent Products: Use the following, unless otherwise indicated:
 - 1. Cellular or screened brick veneer weep / vents designed to be placed just above through-wall flashing in brick veneer head joints at a maximum of 24 inches on center.
- B. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 - 1. Provide one of the following configurations:
 - a. Strips, not less than 3/4 inch thick and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
 - 2. Products:
 - a. Advanced Building Products Inc.; Mortar break
 - b. Archovations, Inc.; CavClear Masonry Mat.
 - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
 - d. Mortar Net USA, Ltd.; Mortar Net.

2.8 CAVITY-WALL INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, closed-cell product extruded with an integral skin.
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures, matching existing.
- C. Matching Existing Masonry: Match coursing, color, and texture of existing masonry.

3.3 CAVITY WALLS

- A. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- B. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as indicated.

3.4 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Except as otherwise indicated, do not allow materials to span existing control and expansion joints without provision to allow for in-plane wall or partition movement.

3.5 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.]
- B. Install flashing as follows, unless otherwise indicated:
 - 1. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
 - 2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 8 inches to form end dams.
 - 3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing.
- D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.6 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry according to brick manufacturer's recommendations.

END OF SECTION 042000

SECTION 04 22 00 – CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units
 - 2. Mortar and grout.
 - 3. Steel reinforcing bars.
 - 4. Masonry-joint reinforcement.
 - 5. Ties and anchors.
 - 6. Embedded flashing.
 - 7. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
 - 1. Cavity wall insulation.
- C. Related Requirements:
 - 1. Section 50 50 00 Metal Fabrications
 - 2. Section 04 05 16 Engineered Masonry Grouting

1.3 COORDINATION

- A. Coordinate all work with job site superintendent and all applicable trades.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, cutting pattern, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315 and ACI 318.
 - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.6 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties material test reports substantiating compliance with requirements.
 - 2. Cementitious materials. Include name of manufacturer, brand name, and type.
 - 3. Mortar admixtures.
 - 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 5. Preblended, dry grout mixes. Include description of type and proportions of ingredients.
 - 6. Reinforcing bars.
 - 7. Joint reinforcement.

8. Anchors, ties, and metal accessories.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. **Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects.**
 1. **Build mockups incorporating concrete masonry units. If not indicated constructed mock up locations shall be selected by the Architect and if acceptable, may remain part of the finished work.**

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar & grout mix in moisture-resistant containers. Store preblended, dry mortar & grout mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 24 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide bullnose units for interior walls at outside corners unless otherwise indicated.
- B. Loadbearing units:
 1. ASTM C 90
 2. Nominal face dimensions: 8" x 16" x width indicated
 3. Lightweight units:
 - a. Dry weight of concrete: Lightweight, 95-105 pcf
 4. Compressive strength over net area: 1700 psi minimum per unit, 1900 psi minimum average for 3 units
- C. Non-loadbearing units:
 1. ASTM C 129
 2. Nominal face dimensions: 8" x 16" x width indicated
 3. Lightweight units:
 - a. Dry weight of concrete: Lightweight, 95-105 pcf.
- D. Precast lintels

1. Shall be 7-5/8" high x lengths as required to bear a minimum of 4" on walls and to continue the bond pattern of the walls.
 2. Lintels shall have reinforcing bar or bars at top and bottom.
 3. One nominal 4" wide by 8" high lintel shall support 400 pounds per lineal foot with a maximum deflection of L/360 unless otherwise indicated on the drawings.
 4. Texture of lintels shall match that of the adjacent concrete masonry units in the same course, unless otherwise indicated.
 5. Lintels shall be scored to match running bond pattern of regular units above such lintels, where exposed in the finished work.
- E. Bond beams:
1. Bond beam reinforcing shall be lapped as noted on the Drawings. Lap splices shall be staggered.
 2. Provide corner bars of same size and quantity as horizontal reinforcement at corners. Corner bar shall lap with straight wall bar with minimum lap length as noted on the Drawings.
 3. Provide same texture and color as wall units in same course, unless otherwise indicated.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I. Provide natural color or white cement as required to produce mortar color indicated.
1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Cement: ASTM C 1329/C 1329M.
- E. Masonry Cement: ASTM C 91/C91M
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- G. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- H. Aggregate for Grout: ASTM C 404.
- I. Water: Potable.

2.5 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.

1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com
 - b. Masonry Reinforcing Corporation of America: www.wirebond.com
 - c. Heckmann Building Products, Inc.: <http://www.heckmannbuildingprods.com/>
 2. Exterior Walls: Hot-dip galvanized carbon steel.
 3. Interior Walls: Mill-galvanized carbon steel.
 4. Wire Size for Side Rods: 0.148-inch diameter.
 5. Wire Size for Cross Rods: 0.148-inch diameter.
 6. Wire Size for Veneer Ties: 0.148-inch diameter.
 7. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 8. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com
 - b. Masonry Reinforcing Corporation of America: www.wirebond.com
 - c. Heckmann Building Products, Inc.: <http://www.heckmannbuildingprods.com/>
 - B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
 2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
 3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.8 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.9 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime, masonry cement or mortar cement mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Field Mixed Mortar: In lieu of preblended mortar mix, mortar can be made on-site from individual components.
- D. Pigmented Mortar: Use colored cement product.
 - 1. Color to match existing.
 - 2. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Clay face brick.
- E. Preblended, Dry Grout Mix: Furnish dry grout ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- F. Field Mixed Grout (from individual components, not preblended) is not permitted.
- G. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2500 psi.
 - 3. Provide grout with a slump of 8 to 10 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.

- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. If units are displaced after mortar has stiffened, remove, clean joints and units of mortar, and relay with fresh mortar.
- G. When joining fresh masonry to set or partially set masonry construction, clean exposed surface of set masonry and remove loose mortar prior to laying fresh masonry.
- H. No open cells or exposed unfinished ends of masonry units are permitted.
- I. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
 - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2-inch total.
- B. Lines and Levels:
 - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
 - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
 - 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
 - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
 - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 - 3. For unexposed head joints and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Concrete Masonry Units: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated.
- C. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars.
 1. Keep cavities free of mortar
 2. Solidly bed webs in mortar where adjacent to reinforced cores or cells.
- D. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.
- E. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- F. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- G. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- H. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- I. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core unless otherwise indicated.
- J. Install slip plane at interface of brick and concrete masonry bands in exterior walls. Place building paper, polyethylene, or flashing in horizontal bed joint below the band. Rake the mortar joint and fill joint with sealant.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches or as required by code.
 1. Space reinforcement not more than 16 inches o.c.
 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.

3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
 1. Provide an open space not less than 1/2-inch-wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch.
 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.9 LINTELS

- A. Install steel lintels where indicated.
- B. Provide concrete or masonry lintels where shown and where openings of more than 24 inches are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Contractor will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.11 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions. Power washing is NOT acceptable.

END OF SECTION

5

DIVISION

METALS

SECTION 05 12 00 — STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. All structural steel framing, including connections and accessories, as shown or implied by the Contract Documents.

B. Related Sections:

1. Division 03 Section: Grouting
2. Division 09 Section: Painting

1.2 QUALITY ASSURANCE

A. Qualifications of Suppliers and Personnel:

1. The steel fabricator and erector shall have successfully completed work of this type and scope. The fabrication facility shall be certified as an AISC Category I facility.
2. All welding shall be performed by operators who have been recently qualified as prescribed in "Structural Welding Code" of the American Welding Society (except for welds which do not carry calculated stress).

B. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with:
2. "Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction
3. "Structural Welding Code" of the American Welding Society
4. "Code of Standard Practice for Steel Buildings and Bridges" of the American Institute of Steel Construction.

C. Conflicting Requirements:

1. In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or this Section of the Project Manual, the provisions of the more stringent shall govern.

D. Fabricators Shop Testing, Inspection and Quality Control:

1. For AISC certified facilities, submit a written program for the proposed fabrication quality control testing and inspection. After review and acceptance of these documents by the Architect/Engineer, perform all shop testing and inspection as specified herein. If the

Fabricator's facility is not AISC certified, the Owner's independent testing laboratory will perform all shop testing and inspection work, and the fabricators will be back-charged for this work.

2. Structural Steel Fabrication Shop Quality Control Program: As a minimum, perform at least the following shop tests and inspections and submit daily reports of the results of all tests. State in each report whether the tested specimens conform to all requirements of the Contract Documents, and specifically note any discrepancies. If the inspections indicate defects in the Work, increase the degree of testing to ensure that the full extent of defects in the joint are found and that similar defects are not present in similar joints.
 - a. Provide evidence that all welders to be employed in the Work hold current AWS certification for the welding procedures that each will perform. If recertification of welders is required, the retesting is the Contractor's responsibility.
 - b. Visually inspect all fabrication operations, including dimensional and fit-up/alignment and control.
 - c. Visually inspect all plate edges and rolled shape edges for material defects.
 - d. High strength bolted connections:
 - 1) Check all bolted connections in accordance with the procedures outlined in the RCSC "Specification for Structural Joints Using ASTM A325 or A490 Bolts", latest edition.
 - e. Welding visual inspection:
 - 1) Inspect all welding operations and welds, including edge preparation, fit-up, preheat, and adherence to welding procedures.
 - a) Inspect welds prior to shop painting of steel.
 - b) Measure the weld profiles for 15 percent of the length of each weld, at random.
 - f. Welding magnetic particle testing: Test in accordance with ASTM E109 for a minimum of:
 - 1) 20 percent of all shear plate fillet welds at random, final pass only.
 - 2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
 - 3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
 - 4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
 - 5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
 - g. Welding ultrasonic testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
 - h. Schedule all work to allow the testing requirements listed above to be completed.

1.3 SUBMITTALS

A. Shop Drawings:

1. Prior to the bulk of shop drawing preparation, submit to the Architect/Engineer shop drawings of "typical conditions" and connections to assure that the fabricators assumptions are correct as to type of connection and other pertinent details.
2. Before any structural steel is fabricated, submit shop drawings to the Architect/Engineer for review and receive approval of same in accordance with Division 01 of this Project Manual.
3. Show all shop and erection details including cuts, copes, connections, holes, threaded fasteners, and welds.
4. Show all welds, both shop and field by the currently recommended symbols of the American Welding Society.

B. Proof of Qualification:

1. Submit to the Architect/Engineer evidence satisfactory to him that the steel fabricator and steel erector are qualified for the Work in accordance with the requirements of this Section of the Project Manual.

C. Certification:

1. Submit to the Architect/Engineer a certification that the materials supplied are in accordance with the requirements of this Section of the Project Manual.

1.4 PROJECT CONDITIONS

A. Field Verification:

1. Confirm all dimensions necessary to make the framing assembly fit accurately.
2. Do not fabricate materials until field dimensions have been confirmed.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. Steel Shapes and Plates:

1. All steel W-shapes shall meet the requirements of ASTM A992 or ASTM A572, Grade 50 except plates, angles and channels shall meet the requirements of ASTM A36.
2. All structural steel exposed to the elements shall be hot dipped galvanized unless noted otherwise on the drawings. All welds and scratches on this steel shall be touched up with a galvanic paint.

B. Hollow Structural Section (HSS):

1. Round, square and rectangular HSS sections shall meet the requirements of ASTM A500, Grade B.

C. Pipes:

1. Steel pipes shall meet the requirements of ASTM A501 or ASTM A53, Grade B, Type E or S.

2.2 CONNECTIONS

A. Materials:

1. High-strength bolts for shop and field connections: ASTM A325, 3/4 inch minimum diameter.
2. Anchor bolts, nuts and washers: ASTM F1554, Grade 2A
3. Machine bolts for minor connections: ASTM A307
4. Shear studs: ASTM A108, Grades 1015 through 1020, Headed-stud type, cold finished carbon steel; AWS D1.1, Type B.
5. Welding electrodes: ASTM A233, Series E70XX

B. All shop connections shall be accomplished using high strength bolts or by welding at the Contractor's option.

C. Use high strength bolts for field connections.

D. Bolted connections shall be bearing type connections with threads in the shear plane.

E. Moment connections as detailed in the Contract Documents are designed as welded connections.

F. All connections shall be consistent with the design assumptions associated with Type "2" or Type "3" construction defined by the American Institute of Steel Construction.

G. Minimum thickness of connection material shall be 5/16" unless noted otherwise.

2.3 PRIMER PAINT

A. General:

1. All primer paint for structural steel shall be compatible with the finish coatings described in Division 09 of this Project Manual.
2. Omit paint from structural steel encased in concrete or designated to receive fireproofing, and from all faying surfaces.
3. Omit paint on all non-corrodible finished angles.

2.4 OTHER MATERIALS

- A. All other materials not specifically described but required for a complete and proper installation of structural steel, shall be new, free from rust, first quality of their respective kinds, and subject to the acceptance of the Architect/Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to installation of the Work of this Section, carefully inspect the installed Work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that existing conditions will permit the structural steel to be fabricated and erected in strict accordance with the original design, the shop drawings, and the referenced standards.

B. Discrepancies:

1. Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 FABRICATION

A. General:

1. Fabricate all structural steel in strict accordance with the shop drawings and the referenced standards.

B. Shop Cleaning and Priming:

1. Shop cleaning shall meet recommendations of the final finish manufacturer.
2. Shop paint all structural steel one coat where priming is required.
3. Thoroughly clean all steel that is not to be painted.

C. Milling:

1. Mill the bearing surfaces of all columns/compression members.

D. Leveling Nuts:

1. All column base plates shall be supported on leveling nuts unless noted otherwise. The area between the base plate and concrete shall be grouted in accordance with Division 03 Section: Grouting.

3.3 WELDING

A. General:

1. For details of joints, comply with requirements for AWS joints accepted with qualification tests.
2. Use ASTM A233, E-70 series electrodes.
3. Follow applicable sections of AWS specifications.

B. Types of Welds:

1. Unless otherwise noted:
 - a. Make all fillet welds 3/16" minimum.
 - b. Make all butt welds full penetration welds, using back-up or chip and back-weld.

3.4 ERECTION

A. General:

1. Erect all structural steel in strict accordance with the drawings, the shop drawings, and all pertinent regulations and standards.

B. Bolted Connections:

1. Accomplish high-strength bolted connections in accordance with the American Institute of Steel Construction's publication, "Specifications for Structural Joints Using ASTM A325 or A490 Bolts."
2. All bolts in bolted connections shall be tightened to the "snug tight condition" unless noted otherwise on the drawings.

C. Touch-Up:

1. After erection is complete:
 - a. Touch-up all shop priming coats damaged during transportation and erection.
 - b. Prime all field welds on members that have been welded and paint all field bolts using the priming paint specified for shop priming.

D. Bracing:

1. Furnish, design, and install all temporary erection bracing.
2. Leave such bracing in place until the structure is stabilized by walls, slabs, decks and permanent bracing.

3.5 INSPECTION AND QUALITY ASSURANCE

- A. The Testing Laboratory will conduct a program of testing and inspection for both shop fabrication and field erection. During shop fabrication, the program will consist of monitoring the structural steel Contractor's quality control and testing program. If the fabrication facility does not qualify as a certified AISC Category I facility, the Testing Laboratory will perform all shop testing and inspection work. During field erection, the program will consist of all field testing and inspection as specified.
- B. Shop Quality Control by Testing Laboratory: Provide periodic monitoring of the Contractor's quality control testing and inspection program. Include the following as a minimum degree of monitoring:
1. Verify all welder qualification and monitor welding procedures and welding processes.
 2. Monitor all fabrication operations.
 3. Verify and monitor all shop testing and inspection, including review of the Contractor's testing and inspection records.
 4. Perform inspection as necessary on those portions of the structural steel not in evidence of complying with the Contract Documents.
- C. Field Quality Control by Testing Laboratory: Perform the following quality control tests and inspections. Interpret test results, submit daily reports and monthly summary reports.
1. Examine the Manufacturer's test certificates for all materials provided. Verify that the lot numbers of the tested material coincide with the lot numbers of the material used on-site.
 2. Visually inspect all anchor-bolt nut installation and tightening.
 3. High strength bolted connections:
 - a. Observe the job site calibration of each size bolted fastener assembly and installation technique in the calibrated tension measuring device. Verify that the proper bolt pretension listed in Table 4 of the RCSC "Specification" is achieved and that installation equipment is of sufficient capacity.
 - b. Routinely monitor field bolting procedures during bolt installation. Verify that all bolts in all connections are brought to a "snug tight" condition with all plies of the connection in firm contact. Verify that bolts in connections identified as either slip-critical or direct tension connections are being additionally tightened by the proper technique(s) determined in the tension testing device described above.
 - c. Check that all bolted connections are being installed in accordance with the procedures outlined in the RCSC "Specification."
 4. Welded connections:
 - a. Obtain qualifications of all welders and verify all welding procedures, including the Contractor's compliance with preheat, weather-protection, electrodes, and welding surface preparation requirements.
 - b. Visually inspect all field welding operations and welds.
 5. Magnetic particle testing: Test in accordance with ASTM E109 for a minimum of:

- a. 20 percent of the length of all field fillet welds, at random, final pass only.
 - b. 25 percent of the length of all field partial penetration welds except column splices, at random, root and final passes.
6. Ultrasonic testing: Test in accordance with ASTM E164 and AWS D1.1 for a minimum of:
- a. 100 percent of all field full penetration welds.
7. Schedule all work to allow the testing requirements listed above to be completed.
8. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
- D. The following procedure shall be followed for inspection and testing of all joints of the seismic force resisting systems:
1. The testing agency responsible for quality assurance shall submit the following documents to the A/E and the owner:
 - a. Qualifications of the management and quality assurance personnel designated for the project.
 - b. Qualification records for the inspectors and non-destructive testing technicians designated for the project.
 - c. Daily or weekly inspection reports including the nonconformance reports.
 2. Inspection points and frequencies of quality assurance task and documentation for the seismic load resisting system shall be as explained below:
 - a. Observe (O): Observe these on a random, daily basis.
 - b. Perform (P): Perform these functions prior to final acceptance of the item.
 - c. Document (D): The inspector shall prepare reports indicating that the work meets the requirements of the contract documents. The report shall indicate the deficiencies and whether the noncompliance has been satisfactorily repaired or not. Inspect after repair and provide a report.
 3. Visual welding inspection shall be the primary method to confirm the procedure materials and the workmanship are as specified and approved. Minimum inspection tasks shall be as follows:
 - a. Observe and perform material identification, joint preparation, dimensions, cleanliness tack weld quality and location, backing type, configuration of the access holes, dimensions and cleanliness of the fillet welds and the field welding process.
 - b. Document visual inspection of the weld for crack, weld/base metal fusion, crater cross-section, weld profile, weld size, undercut, porosity placement of the reinforcement fillets, backing bars/weld tabs removed and finished (if required) and the repair activities.
 - c. Perform and document all repair or corrective work activities.

4. Nondestructive testing of the welds shall be performed by ultrasonic or magnetic particle testing (MT) as follows:
 - a. MT inspection for cracks at welding of doubler plates, continuity plates or stiffeners in the k-area base metal within 3” of weld. Document the findings until accepted.
 - b. Ultrasonic testing shall be performed for all complete joint penetration (CJP) groove weld in materials 5/16” or thicker. Perform MT inspection on 25 percent of all beam-to-column CJP groove welds. Document the findings until accepted.
 - c. Ultrasonic testing for Lamellar Tearing for base metal thicker than 1-1/2”. Document the findings until accepted.
 - d. MT inspection of beam cope and access hole for beams with 1-1/2” or thicker flange. Document the findings until accepted.
 - e. MT inspection of reduced beam section repair and web tab removal sites. Document the findings until accepted.

5. Observation of bolting operations shall be the primary method to confirm the materials procedure and workmanship.
 - a. Verify materials and procedure prior to installation and document the findings until accepted.
 - b. Document data of all rejected connections until accepted.

END OF SECTION 05 12 00

SECTION 05 50 00 — METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish and install all miscellaneous iron, steel, and aluminum items not specifically described in other Sections of these Specifications but required for a complete and operable facility as indicated or implied by the Contract Documents.
2. Provide the following items:
 - a. Loose lintels
 - b. Steel weld plates and angles
 - c. Equipment supports
3. Finish items indicated to be shop finished, painted, or anodized.

B. Related Sections:

1. Division 09 Section "Painting"

1.2 REFERENCES

A. ASTM International (ASTM):

1. A 36 – Standard Specification for Carbon Structural Steel
2. A 53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. A 123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. A 153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. A 307 – Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
6. A 513 – Standard Specification for Electrical-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

B. The Society for Protective Coatings (SSPC):

1. SSPC-SP 6 / NACE No. 3 – Commercial Blast Cleaning
2. SSPC-SP 3 – Power Tool Cleaning
3. SSPC-PA 1 – Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel

1.3 SUBMITTALS

A. Product Data:

1. Paint: Furnish manufacturers product data for primer and finish paints

B. Shop Drawings:

1. Before any metal is fabricated, submit complete shop and setting Drawings for review.
2. Indicate all locations, markings, quantities, materials, sizes, shapes, finish, dimensions, methods of connection, anchoring, fastening, bracing, and attachment to work of other trades.

C. Certifications: Furnish certifications from galvanizer that finished materials comply with standard referenced in this specification.

1.4 QUALITY ASSURANCE

A. Qualifications of Welders:

1. Use only certified welders and the shielded arc process for all welding performed in connection with the Work of this Section.

B. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with:
 - a. AISC - "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings
 - b. AWS - "Code for Welding in Building Construction"

C. Conflicting Requirements:

1. In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

1.5 PRODUCT HANDLING

A. Coordination:

1. Schedule deliveries of fabrications to ensure timely completion of the Work.

B. Dissimilar Metals:

1. Isolate dissimilar metals using neoprene pads, spacers, or gaskets.
2. Asphaltic or bituminous paints may be used in certain installations of dissimilar metals.

- a. Thickness of paint film shall be 10 mil, minimum.

1.6 FIELD MEASUREMENT

- A. Obtain all necessary field measurements to accurately fit this Work with the Work of others.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.
- B. Ferrous Metals:
 1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
 3. Steel Tubing:
 - a. ASTM A 500, cold-formed steel structural tubing.
 - b. ASTM A 513, welded steel mechanical tubing
 4. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- C. Nonferrous Metals:
 1. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy 6063-T6.
 2. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, alloy 6061-T6.
 3. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- D. Fasteners: Select according to location or metals to be fastened. Select fasteners for type, grade, and class required.
 1. Exterior: Type 304 stainless steel fasteners
 2. Exterior walls or areas open to the exterior environment, including soffits and roofs: zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5
 3. Interior subject to water or in corrosive environment: Type 304 stainless steel
 4. Aluminum: Type 304 stainless-steel fasteners.
 5. Stainless steel: Type 304 stainless steel
 6. Steel shapes and miscellaneous uses, unless noted otherwise: ASTM A 307, Grade A.
- E. Bolts And Nuts:
 1. All bolts and nuts for use with steel shapes and miscellaneous uses shall conform to ASTM A307, Grade A.

F. Anchors:

1. Basis-of-Design Product: The design for anchors is based on products manufactured by Hilti, Inc. or ITW Ramset Red Head. Products incorporated in the work shall have equivalent allowable tension and shear load values as the basis-of-design product in the substrate indicated. Alternative diameters and embedment depths may be used, subject to Architect/Engineer approval. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - a. Hilti, Inc.
 - b. ITW Red Head
 - c. Powers Fasteners, Inc.
2. Cast-in-Place Anchors in Concrete: Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
 - a. Design anchors in compliance with ACI 318 Appendix D.
3. Bolts into Concrete or Masonry:
 - a. Adhesive anchor:
 - 1) HIT-RE 500 V3; Hilti Inc.
 - 2) HIT-HY 200; Hilti, Inc.
 - 3) HIT-HY 70; Hilti, Inc.
 - 4) Epcon System; ITW Red Head
 - 5) Pure 110+; Powers Fasteners, Inc.
 - b. Expansion anchor:
 - 1) Kwik Bolt TZ-2; Hilti, Inc.
 - 2) Kwik Bolt 1; Hilti, Inc.
 - 3) Trubolt Wedge Anchor; ITW Red Head
 - 4) Power-Stud System; Powers Fasteners, Inc.
 - c. Drop-in anchor
 - 1) HDI System; Hilti, Inc.
 - 2) Multi-Set II System; ITW Red Head
 - 3) Dropin System; Powers Fasteners, Inc.
 - d. Self-drilling anchors
 - 1) Self-Drill Anchor; ITW Red Head
 - e. Sleeve anchors:
 - 1) HLC Sleeve Anchors; Hilti Inc.

- 2) Dynabolt Sleeve; ITW Red Head
- 3) Power-Bolt System; Powers Fasteners, Inc.
- 4) Lok-Bolt AS; Powers Fasteners, Inc.

G. Welding Electrodes::

1. Arc welding electrodes used shall be only those specifically recommended by the American Welding Society for the purpose indicated.

2.2 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
 1. Fabricate in single lengths for each opening unless otherwise indicated.
 2. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls in compliance with ASTM A 253.
- D. Prime loose steel lintels located in exterior walls with primer specified in Division 09 Section "High-Performance Coatings."

2.3 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.4 EQUIPMENT SUPPORTS

A. Framework:

1. Manufacturers:
 - a. Unistrut Corporation
 - b. Powerstrut
 - c. Hilti USA
2. Sizes as shown on drawings or required to support loads indicated.
3. Provide nuts, bolts, general fittings, and accessories as required for complete installation.
4. Finish shall be equal to Unistrut Greenamel.
5. Provide closure strip for exposed framing in ceilings, acting as equipment support.
 - a. Flush closure strips shall match lay-in ceiling grid.
 - b. Furnish closure strips to Owner for installation after equipment is installed.

6. System shall limit deflection as required by the manufacturer of the equipment being supported. If not indicated by manufacture, limit deflection to L/240.

2.5 OTHER MATERIALS

- A. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107.
- B. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 4000 psi (20 MPa), unless otherwise indicated.
- C. All other materials, not specifically described but required for a complete and proper installation of miscellaneous metal, shall be new, free from rust, best quality of their respective kind, and subject to review by the Architect/Engineer

2.6 STEEL AND IRON FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal fabrications after assembly.
- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 1. Shop prime with universal shop primer unless primers specified in Division 09 Section "High-Performance Coatings" are indicated.
 2. The products of Pratt & Lambert are referenced for standardization.
 - a. FS TT-P 636, Ferrous Metals – P & L Noxide Gray
 - b. FS TT-P-641, Galvanized Metals – P & L Galvanized Primer
 - c. FS TT-P-645, Aluminum – P & L Effecto Enamel
 3. All primer paint shall be compatible with the finish coat specified in Division 09.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Items Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
- F. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint for regalvanizing welds in steel.

2.7 ALUMINUM FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal fabrications after assembly.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
- D. High-Performance Organic Finish:
 1. Comply with AA-C12C40R1x and AAMA 2605.
 2. 3-coat thermocured fluoropolymer finish, 1.2 mil minimum total thickness
 3. Minimum 70 percent polyvinylidene fluoride resin by weight in finish coat and clear topcoat.

PART 3 - EXECUTION

3.1 FABRICATION

- A. Prefabrication:
 1. Insofar as possible, shop fabricate and shop weld all items complete and ready for installation.
- B. Verifying Conditions:
 1. Where metal fabrication items will be used for attachment or support of manufactured equipment, consult appropriate manufacturers and verify that details indicated on the drawings will properly receive and support their equipment.

3.2 WELDING

- A. Shop weld all connections unless otherwise indicated..
- B. Make all joints and intersections of metal tightly fitting and securely fastened. Make all work square, plumb, straight and true.
- C. Dress and finish welds to blend into parent metal.
- D. Where welded aluminum or stainless steel fabrications are required to be joined on-site, provide tight mechanical joints with internal sleeves. Do not field weld unless specifically approved by the Architect/Engineer.

3.3 HOLES

- A. Coordinate location of holes required for Work provided by others.
- B. Drill or punch all holes required for the attachment of Work of other trades for bolted connections.
 - 1. Burned holes are not acceptable.
- C. Provide tapped holes of size and thread necessary to receive other Work.

3.4 STEEL LINTELS

- A. Fabricate lintels to length as required to span rough openings plus 8 inches minimum bearing each side.

3.5 ANCHORS AND CONNECTIONS

- A. Anchors for frames, curbs, sills, and other miscellaneous iron members shown anchored into concrete or masonry shall be strap iron, bent to shape, welded to backs of members, extended with bent end for building in as conditions required, and of sizes and spacing as noted.
- B. Where size and spacing are not noted, anchors shall not be less than 1-1/2" x 1/4" for concrete and 1-1/2" x 1/8" for masonry.
 - 1. Masonry anchors shall be properly spaced to fit the jointing of the adjacent masonry work.
 - 2. Unless otherwise noted on the drawings, anchors shall be spaced 3'-0" or less on centers.
- C. Where anchors and plates or clips are to be built-in for attachment of later work, bolts shall be placed in the plates or clips and welded to back with threaded ends extended as required.
- D. For attaching work to masonry or concrete, where anchors or inserts cannot be built in, provide approved type of cinch anchors and machine bolts or screws. Holes shall be accurately drilled.

3.6 FINISHING

- A. Prepare and Shop prime paint metal fabrications unless otherwise indicated to be unfinished.
 - 1. Do not prime stainless steel unless indicated to be paint finished.
 - 2. Coordinate preparation and application of primers with Work under Division 09 Section "Painting".
- B. Shop finish metal fabrications indicated to receive finish under this section.
 - 1. Finish metal fabrications after fabrication is complete, or in sections fabricated to the greatest extent possible.
 - 2. For fabrications requiring field assembly, provide for field finishing where welding is required and for restoration of damaged finishes to minimize differences in appearance between shop finish and field finish.
 - 3. Anodize aluminum after fabrication. Do not weld aluminum after anodizing.

3.7 INSTALLATION

- A. Coordination:
 - 1. Members to be built into structure or partitions (concrete, masonry, brickwork, or gypsum drywall) shall be furnished to the respective trade for installation.
 - 2. All such items shall be completely fabricated, complete with bolts, anchors, clips, etc., ready to set, and be delivered to the general locations in the Work.
 - 3. Make delivery to points to expedite the installation of delivered materials in their correct locations.
- B. Isolation:
 - 1. Isolate dissimilar materials using neoprene washers, spacers, gaskets, or other approved materials.
 - 2. Isolate aluminum materials from cement or concrete with asphaltic paint or other permanent coating acceptable to manufacturer.
- C. Anchors And Connections:
 - 1. Where necessary to secure steel and iron work to the structure by means of expansion bolts, cinch anchors, or similar connections, lay out and install such connections. Install miscellaneous iron work and secure.
 - 2. All connections made to sleeves, wedge tight with metal wedges and pour the surrounding space full of non-shrink grout and caulked to finish flush with the adjoining surfaces.
 - 3. All miscellaneous vertical members that connect two walls of framing together shall have slotted connections at the top to allow deflection of the floor or roof above.
 - 4. Anchors for frames, curbs, sills, and other miscellaneous iron members shown anchored into concrete or masonry shall be strap iron, bent to shape, welded to backs of members, extended with bent end for building in as conditions required, and of sizes and spacing as noted.

5. Where size and spacing are not noted, anchors shall not be less than 1-1/2" x 1/4" for concrete and 1-1/2" x 1/8" for masonry.
 - a. Masonry anchors shall be properly spaced to fit the jointing of the adjacent masonry work.
 - b. Toggle bolts or other approved devices shall be used for fastening to hollow core masonry.
 - c. Unless otherwise noted on the drawings, anchors shall be spaced 3'-0" or less on centers.
 - d. Make holes in masonry and concrete with rotary drills and drill bits.
 - e. Size anchors to support load indicated or inferable from information provided, with the allowable load and minimum safety factor as recommended by the anchor manufacturer.
6. Where anchors and plates or clips are to be built-in for attachment of later work, bolts shall be placed in the plates or clips and welded to back with threaded ends extended as required.
7. For attaching work to masonry or concrete, where anchors or inserts cannot be built in, provide approved type of cinch anchors and machine bolts or screws. Holes shall be accurately drilled.

3.8 REPAIR AND RESTORATION

- A. Repair, repaint or restore finished items damaged before or during installation to match the original finish.
- B. Repair damaged galvanized surfaces

END OF SECTION 05 55 00

6

DIVISION

WOODS, PLASTICS AND COMPOSITES

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Plastic-laminate cabinets & countertops.
 - 3. Shop finishing of interior woodwork.
 - 4. Miscellaneous hardware and accessories.

1.3 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

- A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- B. Compliance documentation for ASTM E 84 or UL 723 for minimum Class B Flame Spread Index.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products Certified participant in AWI's Quality Certification Program.
- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and wood doors with face veneers that are sequence matched with woodwork and transparent-finished wood doors that are required to be of same species as woodwork.

- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

- B. Wood Species and Cut for Transparent Finish: Match adjacent existing trim in same space as new trim.
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2.
 - 4. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
 - 5. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - a. Pressure Treated Plywood: Provide moisture resistant, treated plywood at all counters containing sinks.
 - 6. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
- D. High-Pressure Decorative Laminate: GP-28, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by the following:
 - a. PL-1: Wilsonart
 - b. Other plastic laminate colors, manufacturers and patterns as indicated on Drawings.
 - 2. Colors and Patterns: Final colors and patterns to be selected from manufacturer's full line.
- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISFA 2-01.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. E. I. du Pont de Nemours and Company; Corian.
 - 2. Type: Standard type or Veneer type made from material complying with requirements for Standard type, as indicated.
 - 3. Colors and Patterns: Refer to Interior Design Drawings.
- F. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear) 2 or 3 (tinted), Quality-Q3, with exposed edges seamed before tempering, 6 mm thick, unless otherwise indicated.

2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Provide cabinet hardware approved in advance by the Architect.
 - 1. Wire Pulls: Back mounted, solid metal..
 - 2. Catches: Magnetic catches, BHMA A156.9, B03141.
 - 3. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.
 - 4. Shelf Rests: BHMA A156.9, B04013; metal.
 - 5. Grommets for Cable Passage through Countertops: As noted on drawings, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - a. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett & Company, Inc.
 - b. Other grommets as indicated on Drawings.
 - 6. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for Design Standard indicated.
 - 7. Satin Stainless Steel: BHMA 630.
 - 8. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
 - 9. Casework Casters: Super cushion rubber.
 - 10. Countertop support brackets: For countertops not supported entirely by casework, provide powder-coated steel supports at a maximum spacing of 48" o.c. Each support bracket shall be capable of supporting 450 lbs. each.
 - a. Finish color to be custom matched.
 - b. Provide products by Federal Brace – Arrowood, or Equal.

2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Contact Adhesive: 250 g/L.
- E. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.4 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).
 2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- F. Install glass to comply with applicable requirements in Division 08 Section "Decorative Glass Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.5 PLASTIC-LAMINATE CABINETS

- A. AWI Type of Cabinet Construction: As indicated.
- B. Reveal Dimension: 1/2 inch or as indicated.
 1. Provide aluminum reveals in finishes indicated.
 2. Submit samples for selection by Architect
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 1. Horizontal Surfaces Other Than Tops: Grade HGS.
 2. Postformed Surfaces: Grade HGP.

3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS.

D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.
2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

F. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by the Architect from the manufacturer's full range of colors.

G. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.6 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. Refer to Division 09 painting Sections for material and application requirements.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

D. Transparent Finish:

1. AWI Finish System: Catalyzed polyurethane.
2. Staining: Match Architect's sample.
3. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
5. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 - a. Apply wash-coat sealer after staining and before filling.

6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

E. Opaque Finish:

1. AWI Finish System: Catalyzed polyurethane.
2. Color: As selected by Architect from manufacturer's full range.
3. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

- A. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- B. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- C. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
- D. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

7

DIVISION

THERMAL & MOISTURE PROTECTION

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Butyl rubber joint sealant

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project Site,

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

- C. Field-Adhesion-Test Reports: For each sealant application tested.
- D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each kind of sealant and joint substrate.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 - 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 2 years from date of Substantial Completion.

- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Manufacturers: Subject to compliance with requirements provide sealants for each substrate and joint condition indicated. Acceptable manufacturers are as follows:
 - 1. Dow Corning
 - 2. GE
 - 3. Pecora
 - 4. Sika-Sarnafil
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, M, NS, 25, NT: Multicomponent, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Use NT.
 - 1. For use at limestone and other masonry joints where indicated.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.6 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Stone and Brick Masonry
 - c. Exterior insulation and finish systems.
 - 3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform one test for each different material.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

9

DIVISION

FINISHES

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension system

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed, high-strength steel studs and tracks, firestop tracks from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 MANUFACTURERS

- A. Provide products from one of the following:
 - 1. Clark Dietrich
 - 2. MarinoWare

2.3 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
 - 2. Protective Coating: ASTM A653/A653M, G40
- B. Studs and Tracks: ASTM C645.
 - 1. Steel Studs and Tracks:
 - a. Minimum Base-Steel Thickness 0.0329 inch
 - b. Depth: As indicated on Drawings
- C. Slip-Type Head Joints: Where indicated, provide[one of] the following:
 - 1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
 - 1. Minimum Base-Steel Thickness: 0.0329 inch.
 - 2. Depth: As indicated on Drawings.

- H. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: As indicated on Drawings
- I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.4 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction.
 - a. Uses: Securing hangers to structure.
 - 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 - 2. Steel Studs and Tracks: ASTM C645.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22 mm) deep.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. USG
 - 2. Armstrong

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of]the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 1. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 2. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.

- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Install all framing at 16 inches on center unless otherwise noted.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

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- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Gypsum wallboard.
 - 2. Gypsum board, Type X.
 - 3. Mold-resistant gypsum board.
 - 4. Cementitious backer units.
 - 5. Water-resistant gypsum backing board.
 - 6. Interior trim.
 - 7. Joint treatment materials.
 - 8. Laminating adhesive.
 - 9. Sound-attenuation blankets.
 - 10. Acoustical sealant.
- B. Samples for Initial Selection: For each type of trim accessory indicated.
- C. Samples for Verification: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockups for the following:
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Manufacturers: Provide products by one of the following:
 - 1. USG
 - 2. National Gypsum

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Thickness: 5/8 inch (15.9 mm).
- B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: As indicated
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
4. For use at all wet areas including interior sink locations and all exterior wall locations.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc
2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221 (ASTM B221M), Alloy 6063-T5.
2. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding, First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound, high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.

- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: As indicated on Drawings
 - 2. Type X: Where required for fire-resistance-rated assembly.
 - 3. Mold-Resistant Type: Wet / plumbing walls and interior face of exterior walls and foundation walls.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws

D. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. U-Bead: Use at exposed edges
 3. Curved-Edge Cornerbead: Use at curved openings.
- D. Aluminum Trim: Install in locations indicated.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Panels that are substrate for tile.
 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 4. Level 5: Where indicated.

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Initial Selection: For components with factory-applied finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Full sized samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 12 inch long Samples of each type, finish, and color.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Layouts of sloped ceiling areas identifying methods and materials used to support, brace and shim ceiling panels and wall support angles on the slopes indicated.
 - 5. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - 6. Size and location of initial access modules for acoustical panels.
 - 7. Items penetrating finished ceiling and ceiling-mounted items including the following:

- a. Lighting fixtures.
- b. Diffusers.
- c. Grilles.
- d. Speakers.
- e. Sprinklers.
- f. Perimeter moldings.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system from ICC-ES.

E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 ACOUSTICAL PANELS

- A. Manufacturers:
 - 1. Provide acoustical ceiling panel and suspension system products by Armstrong Ceilings
 - 2. Equal products from other manufacturers approved in advance by Architect.
- B. ACT-1 – Flat Ceiling Areas
 - 1. 24" x 24" x 1" Tegular Edge
 - 2. Armstrong Ceilings – Random Texture #934 (Design Standard)
 - 3. Suspension System: Existing to remain. Modify as required for minor changes.
- C. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- D. Color: White unless otherwise noted.
- E. Light Reflectance (LR): Not less than 0.85
- F. Noise Reduction Coefficient (NRC): Not less than 0.85
- G. CAC 35
- H. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or

bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers
 - 1. Existing to remain. Modify as required for minor changes
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.
- C. Color: White unless otherwise noted
- D. Suspension system performance: Heavy duty, electrogalvanized steel per ASTM A879/A879M, 9/16" wide

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Post-installed anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F593 and
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
 - 3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
 - 4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than .135 inch diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

- E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - 2. For lay-in panels with reveal edge details, provide stepped edge molding.
 - a. Provide shadow mouldings or reveal edge mouldings for perimeter of all new sloped ceiling areas. Reveal width 3/4".
 - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - 4. Provide standard wall moulding at perimeter of flat ceilings to match existing.
- B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
 - 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 2. Color selected by Architect from manufacturer's full range of available colors
- C. Prefabricated light coves:
 - 1. Armstrong – Axiom Indirect – Ceiling to Wall Classic
 - 2. White finish unless otherwise noted

2.7 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other

Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 5. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m) non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet non-cumulative.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

- A. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- B. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 STANDARD RESILIENT BASE

- A. Standard resilient Base:
- B. Provide the following standard base where required for patching and repair of existing vinyl base to remain.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - d. Flexco, Inc.
 - e. Johnsonite.
 - f. Mondo Rubber International, Inc.
 - g. Musson, R. C. Rubber Co.
 - h. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - i. Roppe Corporation, USA.
 - j. VPI, LLC; Floor Products Division.
- C. Resilient Base Standard: ASTM F 1861
 - 1. Material Requirement: Type TV (PVC - Vinyl) or Type TP (Thermoplastic - Rubber).
 - 2. Manufacturing Method: Group I (solid, homogeneous)
 - 3. Style: Cove (base with toe)
- D. Minimum Thickness: 0.125 inch.
- E. Height: 4 inches
- F. Lengths: Coils in manufacturer's standard length
- G. Outside and Inside Corners: Job formed.
- H. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Endura Rubber Flooring; Division of Burke Industries, Inc.
 - c. Flexco, Inc.
 - d. Johnsonite.
 - e. Mondo Rubber International, Inc.
 - f. Musson, R. C. Rubber Co.
 - g. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
 - h. R.C.A. Rubber Company (The).
 - i. Roppe Corporation, USA. (Basis of Design)
 - j. VPI, LLC; Floor Products Division.

B. Description: Cap for cove carpet, Cap for cove resilient floor covering, Carpet bar for tackless installations, Carpet edge for glue-down applications, Nosing for carpet, Nosing for resilient floor covering, Reducer strip for resilient floor covering, Joiner for tile and carpet, Transition strips.

C. Material: Vinyl or Rubber.

D. Profile and Dimensions: As indicated.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Cove Base Adhesives: Not more than 50 g/L.
 - b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply two coats.
- E. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes modular, tufted carpet tile.
- B. Related Sections include the following:
 - 1. Division 02 Section "Selective Structure Demolition" for removing existing floor coverings.
 - 2. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Existing flooring materials to be removed.
 - 2. Existing flooring materials to remain.
 - 3. Carpet tile type, color, and dye lot.
 - 4. Type of subfloor.
 - 5. Type of installation.
 - 6. Pattern type, location, and direction.
 - 7. Type, color, and location of insets and borders.
 - 8. Type, color, and location of edge, transition, and other accessory strips.
 - 9. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Qualification Data: For Installer.

- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Mockups: Before installing carpet tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, dimensional stability, excess static discharge and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Shaw/Philadelphia Carpet (Basis of Design)
 2. Pattern: Swizzle 54440.
 3. Color: 40700 Pinball
 4. Size: 24" x 24"
 5. Installation: Quarter turn

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:

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1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 2. Remove yarns that protrude from carpet tile surface.
 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099100 – INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Surface preparation, painting, and finishing of exposed interior items and surfaces.
- B. Surface preparation, priming, and finish coats specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.
- C. Painting exposed surfaces whether or not colors are designated in schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
- D. Painting includes field-painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- E. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
- F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 DEFINITIONS

- A. VOC Ranges: Ranges listed are as prescribed by Master Painters Institute (MPI), Architectural Painting Specification Manual as follows:
 - 1. VOC Range E3: Lowest; <51 g/l.
 - 2. VOC Range E2: Next lowest; 51-200 g/l.
 - 3. VOC Range E1: Highest allowable; 201-350 g/l.
 - 4. VOC Range E0: Outside range.
- B. General: Standard coating terms defined in ASTM D16 apply to this section.
 - 1. Low Gloss: Refers to a 'velvet-like' finish with a gloss maximum of 10 when measured with a 60-degree meter per ASTM D523.
 - 2. Low Sheen: Refers to an eggshell finish with a gloss range between 5 and 20 when measured with a 60-degree meter per ASTM D523.
 - 3. Satin: Refers to a low-sheen finish with a gloss range between 15 and 35 when measured with a 60-degree meter per ASTM D523.
 - 4. Semi-gloss: Refers to a satin-like finish with a gloss range between 20 and 35 when measured with a 60-degree meter per ASTM D523.

5. Gloss: Refers to a high-sheen finish with a gloss range higher than 65 when measured with a 60-degree meter per ASTM D523.

1.4 SUBMITTALS

- A. Product Data: For each paint system specified.
 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and coating material proposed for use.
 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing and applying each coating material proposed for use.
 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Initial Samples for Verification Purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate. Architect to provide a list of colors (TBD) up to 20 colors. Full wall conditions.
 1. Submit Sample Brush Outs on same surface as specified for the final application, 8-1/2" x 11" minimum.
 2. Step coats on Samples to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- C. Field Samples for Verification Purposes: Submit samples for review of color and texture; provide list of material and application for each coat of each finish sample. Allow for up to 12 colors.
 1. Brush-Outs: Submit 3 samples of each color and material with texture to simulate actual conditions, on same surface as final installation.
 - a. Submit 8" by 10" samples of wood finishes on actual wood surfaces; label and identify each as to location and application.
 2. Field Samples: Duplicate painted finishes of approved samples on actual wall surfaces and components for approval prior to commencing work.
 - a. Size: Minimum 100 sf located where approved for each color.
 - b. Components: One full component as directed.
 - c. Simulate finished lighting conditions for review.
 3. Opaque Colors and Finishes: Submit samples, on hardboard, using materials accepted for Project, of each color and paint finish selected with texture to simulate actual conditions. Prepare three samples, 8-1/2" by 11", with required number of paint coats clearly visible.
 4. Transparent and Stained Finishes: Prepare samples on species and quality of wood to be used in the Work. Re-submit as requested until acceptable sheen, color, and texture are achieved. Label and identify each sample as to location and application.
- D. Closeout Submittal: Provide paint cards fully labeled with manufacturer of each paint system applied on the project. Provide the following with each system:

1. Manufacturer name.
2. Manufacturer's paint product.
3. Primer name and number.
4. Color name and number.
5. Gloss level.
6. Locations where used.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.
- B. Mockups-Paint: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution prior to commencing work.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 2. Components: One full component as directed.
 3. Simulate finished lighting conditions for review.
 4. Install mock-up using means and methods identical to those that are going to be employed during full production.
 5. Allow coating to cure in accordance with manufacturer's written instructions.
 6. Perform adhesion test on existing paint to remain using X-cut method per ASTM D3359. Ratings 4A and 5A acceptable.
 7. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 8. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
- C. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.
- D. Deliver and store large scale wall graphics rolled over rigid tubes; do not fold large scale wall graphics.

1.7 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- D. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering interior 0-low VOC paint products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore; EcoSpec WB.
 - 2. Glidden Professional; Lifemaster No VOC.
 - 3. Kelly-Moore; Enviro-Cote.
 - 4. Sherwin-Williams; Harmony Coating System.
 - 5. PPG Architectural Finishes; Pure Performance.
- B. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering exterior paint products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore.
 - 2. Glidden Professional.

3. Kelly-Moore.
4. Sherwin-Williams.
5. PPG Architectural Finishes.

2.2 PAINT MATERIALS

- A. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.
- B. Material Quality: Provide the manufacturer's best-quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
- C. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish the manufacturer's material data and certificates of performance for proposed substitutions.
- D. Colors: Match colors indicated by reference to the manufacturer's standard color designations.
- E. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 50 g/L.
 3. Dry-Fog Coatings: 150 g/L.
 4. Primers, Sealers, and Undercoaters: 100 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Floor Coatings: 100 g/L.
 9. Shellacs, Clear: 730 g/L.
 10. Shellacs, Pigmented: 550 g/L.

2.3 PRIMERS

- A. Primers: Provide the manufacturer's recommended factory-formulated primers that are compatible with the substrate and finish coats indicated.
 1. VOC Content: E Range of E2-E3.
- B. Concrete Primers: Factory-formulated alkali-resistant acrylic-latex primer.
- C. Ferrous Metal Primers: Factory-formulated rust-inhibitive water-based metal primer. Use quick drying type at interior applications.
- D. Galvanized Metal Primers: Factory-formulated galvanized metal primer.

- E. Interior Gypsum Board Primer: Factory-formulated white latex-based primer for interior application.

2.4 UNDERCOAT MATERIALS

- A. Undercoat Materials: Provide the manufacturer's recommended factory-formulated oil-based undercoat materials that are compatible with the substrate and finish coats indicated.
 - 1. VOC Content: E Range of E3.
- B. Interior Oil-Based Enamel Undercoat: Ready-mixed oil-based enamel.

2.5 INTERIOR FINISH PAINT MATERIAL

- A. Finish Paint: Provide the manufacturer's recommended factory-formulated finish-coat materials that are compatible with the substrate and undercoats indicated.
 - 1. VOC Content: E Range of E3.
- B. Exterior, Flat, Acrylic Latex-Based Paint: Ready-mixed, acrylic latex-based paint for a flat finish.
- C. Exterior, Semigloss, Acrylic Latex Enamel: Semigloss, acrylic latex enamel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
- C. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.
- D. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Wood: 15 percent.
 - 3. Gypsum Board: 12 percent.
 - 4. Plaster: 12 percent.
- E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes acceptance of substrates and conditions.

3.2 PREPARATION, GENERAL

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items, if necessary, to completely paint the items and adjacent surfaces.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing about anticipated problems using the specified finish-coat material with substrates primed by others.
- D. Follow proper procedures, methods, guidelines, and regulations for paint preparation related to lead paint sanding. Wear goggles, NIOSH-approved respirators, rubber gloves, and appropriate clothing.
- E. Clean building exterior using pressurized hot water.
 - 1. Clean heavily soiled areas with fiber brush and water.
 - 2. Equip pressure washer with fan tip nozzle of 250 degree minimum.
 - 3. Do not permit water temperature to exceed 180 degrees F.
 - 4. Do not permit water pressure to exceed 1,200 psi.
- F. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
- G. Exposed Equipment: Verify installations are complete before initiating preparation of surfaces of exposed mechanical and electrical piping, conduit, ductwork, and equipment for field-painting.
- H. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.
- I. Factory-Primed and Enamel Substrates: Wipe clean and dry.
- J. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

3.3 SURFACE PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
- B. Plaster:

1. Clean plaster adjacent to new repairs so that the paint bonds and blends into new and old, minimum 6 inches beyond repairs.
 2. Allow new plaster to cure thoroughly (30 days minimum) prior to applying paint. Moisture content shall be 8 percent or less, as measured with a moisture meter, at time of paint application.
 3. Scrub surfaces of existing plaster with a solution of 10 percent tri-sodium-phosphate to remove any glaze, and to etch the surface. Wash the solution from the surface using clean water.
 4. Patch cracks, holes and defects with patching plaster. Remove all powder and dust by washing with clear water.
 5. Spot prime patches and stains.
- C. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended know sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 2. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, and paneling.
 - a. When transparent finish is required, backprime with spar varnish.
 3. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
 4. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
- D. Steel Substrates: Clean ungalvanized ferrous metal surfaces that have not been shopcoated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC) and written instructions of paint manufacturer.
1. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 2. Touch up bare areas and shop-applied prime coats that have been damages. Wirebrush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- E. Galvanized-Metal Substrates: Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaminants. Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
1. Treat exterior galvanized surfaces according to SSPC SP-7 and interior galvanized surfaces to SSPS SP-1.
- F. Apply primers to metal surfaces in the field under any of the following circumstances:
1. Where it can be established that shop primer was applied more than 30 days (7 days for some primers, verify with metal shop) before delivery to the site.
 2. If shop-applied primer is contaminated during transport or storage.
 3. If salts are deposited from marine fog, road salts, construction dusts, etc. during storage.

3.4 MATERIALS PREPARATION

- A. Carefully mix and prepare paint materials according to manufacturer's directions.
- B. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
- C. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
- D. Use only thinners approved by the paint manufacturer and only within recommended limits.

3.5 APPLICATION

- A. General: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
- C. Paint colors, surface treatments, and finishes are indicated in the schedules.
- D. Provide finish coats that are compatible with primers used.
- E. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.
- F. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
- G. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
- H. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- I. Do not paint fire-treated plywood backboards to be used for telephone or electrical equipment unless permitted by authorities having jurisdiction.
- J. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
- K. Omit primer on metal surfaces that have been shop-primed and touch-up painted.
- L. Apply traffic paint for striping and other markings with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates for a 15-mil (0.38mm) minimum wet film thickness.

3.6 SCHEDULING PAINTING

- A. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- B. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

3.7 APPLICATION PROCEDURES

- A. Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.
- B. Brushes: Use brushes best suited for the material applied.
- C. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
- D. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- E. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- F. Block Fillers: Apply block fillers to concrete at a rate to ensure complete coverage with pores filled.
- G. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- H. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.
- I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with specified requirements.
- J. Painted surface shall be considered unacceptable if any of the following are evident under final lighting source (including daylight) for interior surfaces:
 - 1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 39-inches (1000 mm).
 - 2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39-inches (1000 mm).
 - 3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
 - 4. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.

5. Coating exhibits lack of full adhesion to surfaces, including but not limited to bubbling, peeling, chipping, and other adhesion defects.

3.8 CLEANING

- A. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017410 Construction Waste Management and Disposal.
- B. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
- C. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.9 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.10 PAINT SYSTEMS SCHEDULES

- A. Schedule: Only major areas are scheduled. Treat miscellaneous and similar items and areas within room or space with similar system.
- B. Number of Coats: Where number of coats are specified, it is only as a minimum requirement. Apply additional coats, at no additional cost to Owner, if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result.
- C. Systems Specifications: These specifications are a guide and are meant to establish procedure and quality. Confer with Architect to determine exact finish desired.
- D. Acceptance of Final Colors: Do not apply final coats of paint for either exterior and interior systems until colors have been accepted by Architect.
- E. Painted surfaces shall be considered unacceptable, as judged solely by the Architect, if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:
 1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 39-inches (1000 mm).
 2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39-inches (1000 mm).
 3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.

4. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.
5. Coating exhibits lack of full adhesion to surfaces, including but not limited to bubbling, peeling, chipping, and other adhesion defects.

3.11 INTERIOR FINISH SCHEDULE

- A. References used in this schedule are based on systems described in the Painting and Decorating Contractors of America, Master Painters Institute, Architectural Painting Specification Manual (MPI).
- E. Gypsum Board Walls:
 1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Oil-based enamel primer/sealer.
 - b. Intermediate Coat: Exterior acrylic latex matching topcoat.
 - c. Topcoat: Exterior acrylic latex (low sheen).
- F. Gypsum Board Ceilings:
 1. Latex (over latex sealer): MPI INT 9.2A.
 - a. Prime Coat: Oil-based enamel primer/sealer.
 - b. Intermediate Coat: Exterior acrylic latex matching topcoat.
 - c. Topcoat: Exterior acrylic latex (low sheen).
- G. Gypsum Board at Toilet Rooms:
 1. Latex System: MPI INT 9.2A.
 - a. Prime Coat: Oil-based enamel primer/sealer..
 - b. Intermediate Coat: Exterior acrylic latex matching topcoat.
 - c. Topcoat: Exterior acrylic latex (semi-gloss, stipple finish).
- H. Stained Wood Base:
 1. Lacquer (over stain): MPI INT 6.3F
 - a. Wood Stain: Interior wood stain (match existing)
 - b. Sealer Coat: Clear lacquer sanding sealer.
 - c. Two Finish Coats: Clear lacquer (satin).

END OF SECTION 099100

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DIVISION

SPECIALTIES

SECTION 101100 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Markerboards.
 - 2. Tackboards.

1.3 DEFINITIONS

- A. Tackboard: Framed, tackable, visual display board assembly.
- B. Tackwall: Unframed, tackable, edge-wrapped visual display board assembly.
- C. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.
- D. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of panel joints.
 - 2. Show locations of special-purpose graphics for visual display surfaces.
 - 3. Include sections of typical trim members.
- C. Samples for Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:
 - 1. Actual sections of each product and finish.
 - 2. Fabric swatches of vinyl or fabric-faced tack assemblies.
 - 3. Include accessory Samples to verify color selected.

- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
- E. Maintenance Data: For visual display surfaces to include in maintenance manuals.
- F. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- C. Mockups: Where field fabrication of visual display surfaces is required, build mockups to verify selections made under sample submittals and to demonstrate appearance and aesthetic effects and set quality standards for installation.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are permanently enclosed, wet work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Porcelain-enamel-clad, ASTM A 463/A 463M, Type 1, stretcher-leveled aluminized steel, with 0.024-inch uncoated thickness; with porcelain-enamel coating fused to steel at approximately 1000 deg F.
 - 1. Gloss Finish: Low gloss; dry-erase markers wipe clean with dry cloth or standard eraser. Suitable for use as projection screen.
 - a. Products: Subject to compliance with requirements, provide the following or equal products by one of the manufacturers listed below.
 - 1) Marsh Industries, Inc.; Visual Products Group.; Retro-Fit Markerboard.
- B. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.
- C. Vinyl Fabric: Mildew resistant, washable, complying with FS CCC-W-408D, Type II, weighing not less than 13 oz./sq. yd.; with surface-burning characteristics indicated.
- D. Hardboard: ANSI A135.4, tempered.
- E. Fiberboard: ASTM C 208.
- F. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.2 RETRO-FIT MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 24 gauge porcelain-enamel face sheet with gloss finish for retro-fit over existing chalk board.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A-1 Visual Systems.
 - b. ADP Lemco, Inc.

- c. Best-Rite Manufacturing
 - d. Claridge Products and Equipment, Inc.
 - e. Ghent Manufacturing, Inc.
 - f. Marsh Industries, Inc.; Visual Products Group. (Basis of Design)
 - g. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - h. PolyVision Corporation; a Steelcase company.
2. Particleboard Core: 3/8 inch thick; with 0.015-inch thick, aluminum sheet backing.
 3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 TACKBOARD / TACKWALL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A-1 Visual Systems.
 2. ADP Lemco, Inc.
 3. Best-Rite Manufacturing
 - a. Best Rite Vin-Tak Boards with Aluminum Trim (Basis of Design)
 4. Claridge Products and Equipment, Inc.
 5. Egan Visual Inc.
 6. Ghent Manufacturing, Inc.
 7. Marsh Industries, Inc.; Visual Products Group.
 8. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 9. PolyVision Corporation; a Steelcase company.
- B. Vinyl-Fabric-Faced Tackboard / Tackwall Assembly: Vinyl-fabric faced 1/4-inch thick, natural cork sheet factory laminated to 1/4 -inch thick hardboard backing.
1. Manufacturer: Best-Rite
 2. Model: Vin-Tak Tack Boards
 3. Aluminum Trim: .88" Profile
 4. Fabric Color: Champagne 41, Pacific Blue 47 or Platinum 56, as selected by Owner.

2.4 RAIL SUPPORT SYSTEM FOR VISUAL DISPLAY BOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Best-Rite Manufacturing.
 2. Egan Visual Inc.
 3. KOH Design, Inc.
 4. PolyVision Corporation; a Steelcase company.
- B. Support Rails: Horizontal, wall-mounted, extruded-aluminum rails designed to receive hanger clip and to support visual display boards; capable of gripping and suspending paper directly from rail.
1. Finish: Clear anodic
 2. Color and Gloss: As selected by Architect from manufacturer's full range.
- C. Hanger Clips: Extruded aluminum with finish to match rails; designed to support independent visual display boards by engaging support rail and top trim of board.

2.5 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.
 - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
 - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, or as indicated on approved Shop Drawings.
 - 2. Provide manufacturer's standard mullion trim at joints between different visual display surfaces of combination units.
 - 3. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
 - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.8 VISUAL DISPLAY SURFACES

1. Provide visual display surfaces in the locations dimensions and configurations indicated on the Drawings.
 - a. Match dimensions of existing units.
 - b. Match existing mounting heights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
 1. Prime wall surfaces indicated to receive direct-applied, visual display tack wall panels and visual display wall coverings and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
 2. Prepare substrates indicated to receive visual display wall covering as required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.

3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, match height of existing conditions. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach visual display boards to wall surfaces with adhesive gobs at 16 inches o.c., horizontally and vertically.
- B. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

3.5 INSTALLATION OF VISUAL DISPLAY WALL PANELS

- A. Marker Wall Sheets: Attach wall sheets to wall surface with thin layer of adhesive over entire wall surface. Butt join adjacent panels.
- B. Marker Wall Panels: Attach panels to wall surface with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.
 - 1. Join adjacent wall panels with concealed steel splines for smooth alignment.
 - 2. Join adjacent wall panels with exposed, H-shaped aluminum trim painted to match wall panel.
- C. Tack Wall Panels: Attach panels to wall surface with egg-size adhesive gobs at 16 inches o.c. horizontally and vertically.
 - 1. Install wrapped-edge wall panels with butt joints between adjacent wall panels.
 - 2. Join adjacent wall panels with exposed, H-shaped aluminum trim covered with same fabric as wall panels.

3.6 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY UNITS

- A. Sliding Visual Display Units: Install units in recessed locations and at mounting heights indicated. Attach to wall framing with fasteners at not more than 16 inches o.c.
 - 1. Adjust panels to operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- B. Visual Display Conference Units: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners through back of cabinet or manufacturer's recommended method.
 - 1. Mounting Height: 72 inches above finished floor to top of cabinet.

3.7 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain motor-operated, sliding visual display units.

END OF SECTION 101100

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DIVISION

FURNISHINGS

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Manually operated roller shades with single rollers.

PART 2 - PRODUCTS

2.1 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Product: Subject to compliance with requirements, provide one of the following products.
1. Draper: FlexShade NEXD (Basis of Design)
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
1. Bead Chains: Stainless steel.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.
 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
1. Roller Drive-End Location: Right side of interior face of shade.
 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
1. Shadeband Material: Light-filtering fabric.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
- G. Installation Accessories:
1. Front Fascia / Surface mounted: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners, for surface mount locations.

- a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches .
2. Header Box / Recessed Mounted: Provide header box, closure panels and brackets for recess mounted roller shades where indicated.
 3. Installation Accessories Color and Finish: As selected from manufacturer's full range of available colors.

2.2 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch . Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

END OF SECTION 122413

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DIVISION

MECHANICAL

DIVISION 20 – MECHANICALSECTION 200100 – GENERAL PROVISIONS - MECHANICALPART 1 – GENERAL:

- 1.1 The Advertisement for Bid, Instructions to Bidders, Bidding Requirements, General, Special and Supplementary Conditions, and all other Contract Documents shall apply to the Contractor's work as well as to each of their Sub-Contractor's work.
- 1.2 All manufacturers, suppliers, fabricators, contractors, etc. submitting proposals for any part of the work, services, materials or equipment to be used on or applied to this project are hereby directed to familiarize themselves with the Contract Documents. In case of conflict between these General Provisions and the General and/or Special Conditions, the Contractor shall contact the Engineer for clarification and final determination prior to the Bid.
- 1.3 The work included in this Division consists of the furnishing of all labor, equipment, transportation, supplies, material, appurtenances and services necessary for the satisfactory installation of the complete and operating Mechanical Systems indicated or specified in the Contract Documents.
- 1.4 Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete any part of the Mechanical Systems in a substantial manner, in compliance with the requirements stated, implied or intended in the Plans and/or Specifications, shall be included in the Bid as part of this Contract.
- 1.5 It is not the intent of this Section of the Specifications to make any Contractor, other than the General Contractor, responsible to the Owner. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be routed through the General Contractor to the Architect, then to the Engineer. Also, this Section of the Specifications shall not be construed as an attempt to arbitrarily assign responsibility of work, material, equipment or services to a particular trade or Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be optional.
- 1.6 The Architect and Engineer do not define the scope of individual trades, subcontractors, material suppliers and vendors. Any sheet numbering system or specification numbering system used which identifies disciplines is solely for the Architect and Engineer's convenience and is not intended to define a subcontractor's scope of work. Information regarding individual trades, subcontractors, material suppliers and vendors may be detailed, described and indicated at different locations throughout the Contract Documents. No consideration will be given to requests for change orders for failure to obtain and review the complete set of Contract Documents when preparing Bids, prices and quotations. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the prime contract.
- 1.7 It is the intent of the Contract Documents to deliver to the Owner a new, complete and operational project once the work is complete. Although Plans and Specifications are complete to the extent possible, it shall be the responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new systems which interfere with new equipment or materials required for the complete installation without additional cost to the Owner.
- 1.8 In general, all work shall be accomplished without interruption of existing facilities operations. The Contractor shall advise the Owner at least seven (7) days prior to the interruption of any services (gas, domestic water, heating, etc.). The Owner shall be advised of the exact time that interruption will occur and the length of time the interruption will last. Failure to comply with this requirement may result in

complete work stoppage for the Contractors involved until a complete schedule of interruptions can be developed.

- 1.9 Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore said service. The Contractor shall provide tools, materials, skilled journeymen of Bidder/Proposer's own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without requests for extra compensation from the Owner.
- 1.10 Each Bidder/Proposer shall also be governed by any unit prices and Addenda insofar as they may affect part of their work or services.
- 1.11 DEFINITIONS AND ABBREVIATIONS:
- Contractor - Any Contractor whether bidding, proposing or working independently or under the supervision of a General Contractor, Prime Contractor, Construction Manager and who installs any type of Mechanical Work as specified in the Contract Documents or, the General Contractor.
 - Engineer - The Consulting Mechanical-Electrical Engineer either consulting to the Owner, Architect, or Other, etc. In this case: CMTA, Inc., Consulting Engineers.
 - Architect - The Architect of Record for the project.
 - Contract Documents - All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Contract with Owner, etc.
 - Bidder/Proposer - Any person, agency or entity submitting a proposal to any person, agency or entity for any part of the work required under this contract.
 - The Project - All of the work required under this Contract.
 - Furnish - Deliver to the site in good condition and turn over to the Contractor who is to install.
 - Provide - Furnish and install complete, tested and ready for operation.
 - Install - Receive and place in satisfactory operation.
 - Indicated - Listed in the Specifications, shown on the Plans or Addenda thereto.
 - Typical or Typ.- Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
 - ADA - Americans with Disabilities Act.
 - AGA - American Gas Association
 - ANSI - American National Standards Institute.
 - ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers.
 - ASME - American Society of Mechanical Engineers.
 - IBC - International Building Code.
 - NEC - National Electrical Code.
 - NEMA - National Electrical Manufacturers Association.
 - NFPA - National Fire Protection Association.
 - OSHA - Office of Safety and Health Administration.
 - SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
 - UL - Underwriters Laboratories.

PART 2 – INTENT AND INTERPRETATION:

- 2.1 It is the intention of the Contract Documents to call for a complete and operational system, including all components, accessories, finish work, etc as necessary for trouble free operation; tested and ready for operation. Anything that may be required, implied, or inferred by the Contract Documents shall be provided and included as part of the Bid.

- 2.2 All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- 2.3 Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- 2.4 The Bidder/Proposer shall completely review the Contract Documents. Any interpretation as to design intent or scope shall be provided by the Engineer / Architect. Should an interpretation be required, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event of any conflict, discrepancy, or inconsistency develops; the interpretation of the Engineer shall be final.
- 2.5 The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten (10) days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in the bid, and that will be responsible for the approved satisfactory functioning of the entire system without extra compensations.

PART 3 – INDEMNIFICATION:

- 3.1 The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

PART 4 – PLANS AND SPECIFICATIONS:

- 4.1 The Plans are diagrammatic only and indicate the general arrangement of the systems and are to be followed. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted to the Engineer for approval before proceeding with the work. The Plans are not intended to show every item which may be necessary to complete the systems. All Bidder/Proposers shall anticipate that additional items may be required and submit their Bid accordingly.
- 4.2 The Plans and Specifications are intended to supplement each other. No Bidder/Proposer shall take advantage of conflict between them, or between parts of either. Should this condition exist, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be final.
- 4.3 The Plans and Specifications shall be considered to be cooperative and anything appearing in the Specifications which may not be indicated on the Plans or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.

- 4.4 Contractor shall make all of their own measurements in the field and shall be responsible for correct fitting. The work shall be coordinated with all other branches of work in such a manner as to cause a minimum of conflict or delay.
- 4.5 The Engineer shall reserve the right to make adjustments in location of piping, ductwork, equipment, etc. where such adjustments are in the interest of improving the project.
- 4.6 Should conflict, overlap or duplication of work between the various trades become evident, this shall be called to the attention of the Engineer. In such event neither trade shall assume to be relieved of the work which is specified under their branch until instructions in writing are received from the Engineer.
- 4.7 Unless dimensioned, the Plans only indicate approximate locations of equipment, piping, ductwork, etc. Dimensions given in figures on the Plans shall take precedence over scaled dimensions and all dimensions, whether given in figures or scaled, shall be verified in the field to ensure no conflict with other work.
- 4.8 Each Bidder/Proposer shall review all Plans in the Contract Documents to ensure that the work they intend to provide does not create a conflict with or affect the work of others in any way. Where such effect does occur it shall be the Bidder/Proposer's responsibility to satisfactorily eliminate any such conflict or effect prior to the submission of their proposal. Each Bidder/Proposer shall in particular ensure that there is adequate space to install their equipment and materials. Failure to do so shall result in the correction of such encroachment conflict or effect of any work awarded the Bidder/Proposer and shall be accomplished fully without expense to others and that they are reasonably accessible for maintenance. Check closely all mechanical and electrical closets, chases, ceiling voids, wall voids, crawl spaces, etc., to ensure adequate spaces.
- 4.9 Where on the Plans a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornamentation or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.
- 4.10 Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- 4.11 Where within the Contract Documents the word "typical" or "typ." is used, it shall mean that the work method or means indicated as typical shall be repeated in and each time it occurs whether indicated or not.
- 4.12 Each Contractor shall evaluate ceiling heights specified on Architectural Plans. Where the location of equipment or systems may interfere with ceiling heights or maintenance and access of equipment or systems, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Do not install equipment or systems in the affected area until the conflict is resolved. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work or cost incurred on the part of the Contractor or unduly delay the work.

PART 5 – EXAMINATION OF SITE AND CONDITIONS:

- 5.1 Each Bidder/Proposer shall inform themselves of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground and above grade, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work.
- 5.2 Each Bidder/Proposer shall also fully acquaint themselves with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of utilities, etc. A proposal shall cover all expenses or disbursements in connection with such

matters and conditions. No allowance will be made for lack of knowledge concerning such conditions after Bids are accepted.

PART 6 – EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS:

- 6.1 When any Contractor requests approval of materials and/or equipment of different physical size, weight, capacity, function, color, access, then the design allows for it shall be understood that such substitution, if approved, will be made without additional cost to anyone other than the Contractor requesting the change regardless of changes in connections, space requirements, electrical characteristics, etc. from that indicated, electrical service, etc. In all cases where substitutions affect other trades, the Contractor requesting such substitutions shall advise all such Contractors of the change and shall compensate them for all necessary changes in their work. Any Plans, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Review of Shop Drawings by the Engineer does not in any way absolve the Contractor of this responsibility.
- 6.2 Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form, or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition; any devices, products, materials, fixtures, forms, or types of construction which, in the judgment of the Engineer, are equivalent to those specified are acceptable, provided the provisions of this Part are met. Requested substitutions shall be submitted to the Engineer a minimum of ten (10) days prior to Bid. If this procedure is not followed, the substitution will be rejected. If prevailing laws of cities, towns, states or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- 6.3 Wherever any equipment and material is specified exclusively only such items shall be used unless substitution is accepted in writing by the Engineer.
- 6.4 Each Bidder/Proposer shall furnish along with their proposal a list of specified equipment and materials which is to be provided. Where several makes are mentioned in the Specifications and the Contractor fails to state which they propose to furnish, the Engineer shall choose any of the makes mentioned without change in price. Inclusion in this list shall not ensure that the Engineer will approve shop drawings unless the equipment, materials, etc., submitted in shop drawings are satisfactorily comparable to the items specified and/or indicated.

PART 7 – CODES, RULES, PERMITS, FEES, INSPECTIONS, REGULATIONS, ETC.:

- 7.1 The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, inspections and other costs, including all utility connections, meters, meter settings, taps, tap fees, extensions, etc. in connection with their work. They shall also file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments and/or the appropriate municipality or utility company having jurisdiction, whether indicated or specified or not. They shall also obtain all required certificates of inspection for their work and deliver same to the Engineer before request for acceptance and final payment for the work.
- 7.2 Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- 7.3 The Contractor shall include in their work, without extra cost, any labor, materials, services, apparatus and Plans in order to comply with all applicable laws, ordinances, rules and regulations, whether or not indicated or specified.
- 7.4 All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, with the requirements of local utility companies, or municipalities and with the requirements of all governmental agencies having jurisdiction.

- 7.5 All materials and equipment so indicated and all equipment and materials for the electrical portion of the mechanical systems shall bear the approval label of, or shall be listed by the Underwriters' Laboratories (UL), Incorporated. Each packaged assembly shall be approved as a package. Approval of components of a package shall not be acceptable.
- 7.6 All plumbing work is to be constructed and installed in accordance with applicable codes, Plans and Specifications which have been approved in their entirety and/or reflect any changes requested by the Authority Having Jurisdiction. Plumbing work shall not commence until such Plans are in the possession of the Plumbing Contractor.
- 7.7 All Heating, Ventilation and Air Conditioning work shall be accomplished in accordance with the Building Code and amendments thereto, the latest standards recognized by the American Society of Heating, Refrigerating and Air Conditioning and the National Fire Protection Association.
- 7.8 The Contractor shall furnish three (3) copies of all Final Inspection Certificates obtained to the Engineer when work is complete. Final payment for work will be contingent upon compliance with this requirement.
- 7.9 Where minimum code requirements are exceeded in the Design, the Design shall govern.
- 7.10 The Contractor shall ensure that their work is accomplished in accord with the OSHA Standards and that they conduct their work and the work of their personnel in accord with same.
- 7.11 All work relating to the handicapped shall be in accord with regulations currently enforced by the Authority Having Jurisdiction and the American Disabilities Act.
- 7.12 All work in relation to domestic water systems shall, in addition to all other Codes, Rules, Regulations and Standards, be in compliance with the requirements of the local water utility company.
- 7.13 Discharge of any toxic, odorous or otherwise noxious materials into the atmosphere or any system shall be subject to regulations of the Environmental Protection Agency (EPA) and/or the air pollution control commission. If in doubt, contact the State Department for Environmental Protection.
- 7.14 Where conflict arises between any code and the Plans and/or Specifications, the code shall apply except in the instance where the Plans and Specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten (10) days prior to bid date, otherwise the Contractor shall make the required changes at their own expense.

PART 8 – QUALIFICATIONS OF CONTRACTOR/WORKERS:

- 8.1 All Mechanical Contractors and their subcontractors bidding this project must have been a licensed company for a minimum of three (3) years to qualify to Bid this project. Individual employee experience does not supersede this requirement.
- 8.2 All mechanical subcontractors bidding the mechanical work must have completed one project of 70% this subcontract cost size and two projects of 50% this subcontract cost size.
- 8.3 All mechanical work shall be accomplished by qualified workers competent in the area of work for which they are responsible. Untrained and incompetent workers, as evidenced by their workmanship, shall be summarily relieved of their responsibilities in areas of incompetency. The Engineer shall reserve the right to determine the quality of workmanship of any workers and unqualified or incompetent workers shall refrain from work in areas not deemed satisfactory. Requests for relief of workers shall be made through the normal channels of Architect, Contractor, etc.

- 8.4 The Contractor shall hold all required licenses in the State which the work is to be performed.
- 8.5 All plumbing work shall be accomplished by Journeymen Plumbers under the direct supervision of a Master Plumber as defined under State Plumbing Law Regulations and Code. Proof and Certification may be requested by the Engineer.
- 8.6 The installation of all Heating, Ventilating and Air-Conditioning Systems (HVAC) by any Contractor, whether in existing or new building construction shall be performed by a Licensed Master HVAC Contractor. This includes any Contractor installing HVAC systems, piping and ductwork.
- 8.7 All sheet metal, insulation and pipe fitting work shall be installed by workers normally engaged in this type work.
- 8.8 All automatic control systems shall be installed by workers normally engaged or employed in this type work.
- 8.9 All electrical work shall be accomplished by Licensed Journeymen electricians under the direct supervision of a licensed Electrician. All applicable codes, utility company regulations, laws and permitting authority of the locality shall be fully complied with by the Contractor.

PART 9 – SUPERVISION OF WORK:

- 9.1 The Contractor shall personally supervise the work for which they are responsible or have a competent superintendent, approved by the Engineer, on the work at all times during progress with full authority to act on behalf of the Contractor.

PART 10 – CONDUCT OF WORKERS:

- 10.1 The Contractor shall be responsible for the conduct of all workers under their supervision. Misconduct on the part of any worker to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt removal of that worker. The consumption of alcoholic beverages or other intoxicants, narcotics, barbiturates, hallucinogens or debilitating drugs on the job site is strictly forbidden.

PART 11 – COOPERATION AND COORDINATION WITH OTHER TRADES:

- 11.1 The Contractor shall give full cooperation to all other trades and shall furnish in writing with copies to the Engineer, any information necessary to permit the work of other trades to be installed satisfactorily and with the least possible interference or delay.
- 11.2 Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than $\frac{1}{4}'' = 1'-0''$, clearly indicating how their work is to be installed in relation to the work of other trades, or so as not to cause any interference with work of other trades. Make the necessary changes in the work to correct the condition without extra charge.
- 11.3 The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

PART 12 – GUARANTEES AND WARRANTIES:

- 12.1 The Contractor shall guarantee all equipment, apparatus, materials, and workmanship entering into their Contract to the best of its respective kind and shall replace all parts at their own expense, which are proven

defective within the time frame outlined in the General Conditions of the Contract. The effective date of completion of the work shall be the date of the Project's Statement of Substantial Completion. Items of equipment which have longer guarantees, as called for in these Specifications, shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Engineer shall then submit these warranties, etc. to the Owner. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall not invalidate the guarantee except that the Owner shall be liable for any damage to equipment during this period, due to negligence of their operator or other employees. Refer to other sections for any special or extra warranty requirements.

- 12.2 All VFD's shall have a two year warranty. (Parts and Labor).
- 12.3 Provide all warranty certificates to Owner. All warranties begin starting at the substantial completion date, submit warranty certificates accordingly.

PART 13 – COST BREAKDOWNS (SCHEDULE OF VALUES):

- 13.1 Within thirty (30) days after acceptance of the Contract, the Contractor shall furnish to the Engineer, one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made in a format approved by the Engineer. Payments will not be made until satisfactory cost breakdowns are submitted.
- 13.2 The breakdown shall be minimally as follows. Material and labor shall be listed separately. Pay special attention to required withholding percentages for startup, testing, documentation, acceptance, owner training, etc.:
- Mechanical Shop Drawings
 - Motor Load Coordination with other subcontractors
 - Mechanical Record Drawings & Acceptance
 - Mechanical O&M Manuals & Acceptance
 - Mechanical Owner Training & Acceptance
 - Spare Parts
 - Coordination Drawings
 - Mechanical Identification Materials & Labor
 - HVAC Piping Materials & Labor
 - HVAC Piping Testing, Cleaning, Documentation, Acceptance, etc.
 - HVAC Piping Purging, Flushing, Cleaning
 - Insulation (Piping) Materials & Labor
 - Insulation (Ductwork) Materials & Labor
 - Plumbing Fixtures and Equipment
 - Plumbing Materials, Piping & Labor
 - Plumbing Shop Fabrication
 - Domestic Water Heater Equipment & Labor
 - Domestic Water Heater Startup, Testing, Documentation, Training, Acceptance, etc.
 - Sheetmetal Equipment
 - Sheetmetal Materials & Labor
 - Sheetmetal Shop Fabrication
 - Ductwork Air Leakage Testing, Documentation, Acceptance, etc.
 - Filters and Racks Materials & Labor
 - DOAS Equipment & Labor
 - DOAS start-up testing Documentation, Training, Acceptance, etc.
 - Air Handling Unit Equipment & Labor

- Air Handling Unit Startup, Testing, Documentation, Training, Acceptance, etc.
- Energy Recovery Unit Equipment & Labor
- Energy Recovery Unit Startup, Testing, Documentation, Training, Acceptance, etc.
- Dehumidification Unit Equipment & Labor
- Dehumidification Unit Startup, Testing, Documentation, Training, Acceptance, etc.
- Cooling Tower Equipment & Labor
- Cooling Startup, Testing, Documentation, Training, Acceptance, etc.
- Chiller Equipment & Labor
- Chiller Startup, Testing, Documentation, Training, Acceptance, etc.
- Boiler Equipment & Labor
- Boiler Startup, Testing, Documentation, Training, Acceptance, etc.
- Pump Equipment & Labor
- Pump Startup, Testing, Documentation, Training, Acceptance, etc.
- Other HVAC Equipment & Labor
- Other HVAC Equipment Startup, Testing, Documentation, Training, Acceptance, etc.
- Chemical Treatment Materials & Labor
- Chemical Treatment Pre-Testing
- Chemical Treatment Startup, Testing, Documentation, Training, Acceptance, etc.
- Controls Front-end Interface (Allowance)
- Controls Commissioning Plan
- Controls Shop Drawings
- Controls Materials & Labor
- Controls Graphics
- Controls Record Drawings
- Controls Startup, Commissioning, Testing, Documentation, etc.
- Controls Training and Acceptance
- Test and Balance Materials & Labor
- Test and Balance Pre-Testing
- Test and Balance Initial Report, Final Report and Acceptance

PART 14 – CHANGES IN MECHANICAL WORK:

14.1 REFER TO GENERAL AND SPECIAL CONDITIONS.

PART 15 – CLAIMS FOR EXTRA COST:

15.1 REFER TO GENERAL AND SPECIAL CONDITIONS.

PART 16 – MATERIALS AND WORKMANSHIP:

16.1 All equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. Each Bidder/Proposer shall determine that the materials and/or equipment they propose to furnish can be brought into the building(s) and installed within the space available. In certain cases, it may be necessary to remove and replace walls, floors and/or ceilings and/or disassemble/reassemble the materials and equipment and this work shall be the responsibility of the Contractor, whether specifically initiated or not.

16.2 All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement of fans, motors, coils, filters, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s). Ensure, through coordination that no other Contractor seals off access to space required for equipment materials, etc.

- 16.3 Materials and equipment shall bear Underwriters' Laboratories label where such a standard has been established, where applicable.
- 16.4 Each length of pipe, fitting, trap, fixture and device used in the plumbing or drainage systems shall be stamped or indelibly marked with the weight or quality thereof and with the manufacturer's mark or name.
- 16.5 All equipment shall bear the manufacturer's name and address. All electrically operated equipment shall bear a name plate indicating required horsepower, voltage, phase and ampacity. Pumps and fans shall have a data plate indicating horsepower, pressure and flow rate.

PART 17 – HAZARDOUS MATERIALS:

- 17.1 The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building or site.
- 17.2 Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of their work, ensure that their workers are aware of this potential and what they are to do in the event of suspicion. The Contractor shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall ensure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.
- 17.3 CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.
- 17.4 If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner and so advise them immediately.
- 17.5 The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.
- 17.6 No asbestos or mercury containing materials shall be installed in this project.

PART 18 – TEMPORARY SERVICES:

- 18.1 The Contractor shall arrange any temporary water, electrical and other services which may be required to accomplish the work. Refer also to General and Special Conditions.
- 18.2 All temporary services shall be removed by Contractor prior to completion of work.

PART 19 – SURVEY, MEASUREMENTS AND GRADE:

- 19.1 The Contractor shall lay out their work and be responsible for all necessary lines, levels, inverts, elevations and measurements. The Contractor must verify the figures shown on the Plans before laying out the work and will be held responsible for any error resulting from failure to do so.

- 19.2 The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.
- 19.3 Should the Contractor discover any discrepancy between actual measurements and those indicated which prevents following good practice or the intent of the contract documents, the Contractor shall promptly notify the Engineer and shall not proceed with this work until the Contractor has received instructions from the Engineer on the disposition of the work.

PART 20 – PROTECTION OF EQUIPMENT:

- 20.1 The Contractor shall be entirely responsible for all material and equipment they furnish in connection with their work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. All piping, etc., shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged, stolen or vandalized while stored on site, either before or after installation, shall be repaired or replaced by the Contractor at their expense. All ductwork with open ends shall be covered with plastic during construction.

PART 21 – REQUIRED CLEARANCES FOR ELECTRICAL EQUIPMENT:

- 21.1 The NEC has specific required clearances above, in front, and around electrical gear, panels etc. The Contractor shall not install any piping, ductwork, etc., in the required clearance. If any appurtenance is located in the NEC required clearance, it shall be relocated at no additional cost. Coordinate with the Electrical Contractor prior to any work.

PART 22 – EQUIPMENT SUPPORT:

- 22.1 Each piece of equipment, apparatus, piping, or conduit suspended from the ceiling or mounted above the floor level shall be provided with suitable structural support, pipe stand, platform or carrier in accordance with the best recognized practice. Such supporting or mounting means shall be provided by the Contractor for all equipment and piping. Exercise extreme care that structural members of building are not overloaded by such equipment. Provide any required additional bracing, cross members, angles, support, etc. Do not support items from roof/floor deck or bridging.

PART 23 – DUCT AND PIPE MOUNTING HEIGHTS:

- 23.1 All exposed or concealed ductwork, piping, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed piping and ductwork shall, insofar as possible, run perpendicular or parallel to the building structure. Refer to Plans for minimum heights of ducts and piping. Minimum height above ceilings shall be 6” clear including insulation, unless otherwise noted.

PART 24 – BROKEN LINES AND PROTECTION AGAINST FREEZING:

- 24.1 No conduits, piping, etc. carrying water or any other fluid subject to freezing shall be installed in any part of the building where danger of freezing may exist without adequate protection being given by the Contractor whether or not insulation is specified or indicated on the particular piping. All damages resulting from broken and/or leaking lines shall be replaced or repaired at the Contractor's own expense. Do not install piping across or near openings to the outside whether or not they are carrying static or moving fluids. Insulation on piping does not necessarily ensure that freezing will not occur. If in doubt, contact the Engineer.

PART 25 – WEATHERPROOFING:

- 25.1 Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as specified and approved by the Architect and Engineer before work is performed. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings permanently watertight.
- 25.2 Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

PART 26 – ACCESSIBILITY:

- 26.1 The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in double partitions and ceilings for the proper installation of their work. They shall cooperate with all others whose work is in the same space. Such spaces and clearances shall, however, be kept to the minimum size required.
- 26.2 The Contractor shall locate and install all equipment so that it may be serviced, and maintained as recommended by the manufacturer. Allow ready access and removal of the entire unit and/or parts such as valves, filters, fan belts, motors, prime shafts, controls, coils, etc.
- 26.3 Whether shown on the Plans or not, the Contractor shall provide in the Bid access panels for each concealed shut-off valve, motorized control damper, manual air damper or other device requiring service as shown on Engineer's Plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. Change orders for access panels will not be accepted.

PART 27 – SCAFFOLDING, RIGGING AND HOISTING:

- 27.1 The Contractor shall furnish all scaffolding, rigging, hoisting and services necessary for erection and delivery onto the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

PART 28 – CONCRETE WORK:

- 28.1 The Contractor shall be responsible for the provisions of all concrete work required for the installation of any of their systems or equipment. The Contractor may, at their option, arrange with the others to provide the work. This option, however, will not relieve the Contractor of their responsibilities relative to dimensions, quality of workmanship, locations, etc.
- 28.2 In the absence of other concrete Specifications, all concrete related to Mechanical work shall be 3500 psi minimum compression strength at 28 days curing, slump: 4" ± 1", air entrainment 4.5% water to cement ratio 0.5 and shall conform to the standards of the American Concrete Institute Publication AC1-318. Heavy equipment shall not be installed on pads for at least seven (7) days after pour.
- 28.3 All concrete pads shall be complete with all pipe sleeves, anchor bolts, reinforcing steel, concrete, etc. as required. Pads larger than 18" in width shall be reinforced with ½" deformed round bars on 6" centers both ways. Bars shall be approximately 2" above the bottom of the pad. All parts of pads and foundations shall be properly rodded or vibrated. If exposed parts of the pads and foundations are rough or show honeycomb after removing forms, all surfaces shall be rubbed to a smooth surface. Chamfer all vertical edges ¾" and tool horizontal edges with ¾" radius.
- 28.4 In general, unless otherwise noted, concrete pads for equipment shall be 4" thick, extend six (6) inches beyond the equipment's base dimensions. Where necessary, extend pads 30 inches beyond base or overall dimensions to allow walking and servicing space. Insert 6-inch steel dowel rods into new and existing floors to anchor pads.

- 28.5 Exterior concrete pads shall be 8" thick with four (4) inches minimum above grade and four (4) inches below grade on a compacted four (4) inch dense grade rock base unless otherwise indicated or specified. Surfaces of all foundations and bases shall have a smooth finish with one-half (1/2) inch chamfer on exposed edges. Turn down edges 18" below grade.

PART 29 – RESTORATION OF NEW OR EXISTING LANDSCAPING, PAVING, SURFACES, ETC.:

- 29.1 The Contractor shall at their expense restore to their original conditions all paving, curbing, surfaces, drainage ditches, structures, fences, landscaping, existing or new building surfaces and appurtenances, and any other items damaged or removed by their operations. Replacement and repairs shall be in accordance with good construction practice; by qualified tradesman, and shall match materials employed in the original construction of the item and shall be to the satisfaction of the Owner and/or Engineer.

PART 30 – MAINTENANCE OF EXISTING UTILITIES AND LINES:

- 30.1 The locations of all piping, conduits, cables, utilities and manholes existing, or otherwise, that comes within the contract construction site, shall be subject to continuous uninterrupted service with no other exception than the Owner of the utilities permission to interrupt same temporarily. Provide a seven (7) day written notice to Engineer, Architect and Owner prior to interrupting any utility service or line.
- 30.2 Known utilities and lines as available to the Engineer are shown on the Plans. However, it is additionally required that, prior to any excavation being performed, each Contractor ascertain and mark all utilities or lines that would be endangered by the excavation. Hand dig if required to locate. Contractor shall bear costs of repairing damaged utilities.
- 30.3 If utilities or lines occur in the earth within the construction site, the Contractor shall probe and locate the lines prior to machine excavation in the respective area. Hand dig if required to locate.
- 30.4 Cutting into existing utilities and services shall be performed in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or accidental interruption, providing premium time and materials as needed without extra claim to the Owner.
- 30.5 The Contractor shall repair to the satisfaction of the Owner and Engineer, any surfaces or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
- 30.6 Machine excavation shall not be permitted with ten feet of gas lines, fuel lines, electrical lines or lines carrying combustible and/or explosive materials. Hand excavate only in accord with utility company, agency or other applicable laws, standards or regulations.
- 30.7 Protect all new or existing lines from damage by traffic, etc. during construction. Repairs or replacement of such damage shall be at the sole expense of the party responsible.

PART 31 – CLEANING:

- 31.1 The Contractor shall, at all times, keep the area of their work presentable to the public and clear from rubbish and debris caused by their operations; and at the completion of the work, they shall remove all rubbish, debris, all of their tools, equipment, temporary work and surplus materials from and about the premises, and shall leave the area clean and ready for use. If the Contractor does not attend to such cleaning upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the Contractor. The Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of their rubbish or debris.

- 31.2 After completion of all work and before final acceptance of the work, the Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of piping, equipment, fixtures and all other associated or adjacent fabrication.
- 31.3 Ductwork and piping shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4" above the floor and the open ends shall be completely covered in plastic. Open ends of installed ductwork shall be protected with plastic. Do not install the ductwork or insulation (pipe or duct) if the building is not "dried-in". The Owner/Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing a NADCA certified Contractor.

PART 32 – TEMPORARY USE OF EQUIPMENT:

- 32.1 The permanent heating and plumbing equipment, when installed, may be used for temporary services, with the consent of the Engineer. Use of the permanent equipment shall be dependent upon the cleanliness of the job site as determined by Owner, Architect and Engineer. Should the permanent systems be used for this purpose the Contractors shall make all temporary connections required at their expense. They shall also make any replacement required due to damage wear and tear, etc., leaving the same in "as new" condition.
- 32.2 Permission to use the permanent equipment does not relieve the Contractors from the responsibility for any damages to the building construction and/or equipment which might result because of its use.
- 32.3 Warranties shall begin at substantial completion regardless of temporary use of equipment or not.
- 32.4 A pre-start-up conference shall be held in accordance with EQUIPMENT/CONTROLS START-UP AND VERIFICATION in this section.
- 32.5 For Air Handling Units during all phases of construction:
- At a minimum, four complete sets of filter media are required for each unit. In each unit, install two sets of filter media during construction (more shall be required if construction activities dictate more frequent changes). In each unit, install one set of filter media at substantial completion. Leave one set of filter media in boxes in appropriate mechanical room as a spare set for the Owner. All other filters shall be used by the Contractor during construction. Dispose of all construction filter media.
 - On the outside of all return air openings install a minimum of two sets of fiberglass filter media, such as cheesecloth, to be utilized as pre-filters for the "construction" filters. Install first set upon start-up and then install second set when first set is dirty. Dispose of all dirty construction filters. Change filters as often as necessary to keep units from becoming dirty at no additional cost.
 - At substantial completion of the project the entire unit shall be cleaned to present a like "new" unit for the Owner and all filters shall be replaced with new.
- 32.6 For Outside Air Units during all phases of construction:
- At a minimum, four complete sets of filter media are required for each unit. In each unit, install two sets of filter media during construction (more shall be required if construction activities dictate more frequent changes). In each unit, install one set of filter media at substantial completion. Leave one set of filter media in boxes in appropriate mechanical room as a spare set for the Owner. All other filters shall be used by the Contractor during construction. Dispose of all construction filter media.
 - On the outside of all exhaust air openings install a minimum of two sets of fiberglass filter media, such as cheesecloth, to be utilized as pre-filters for the "construction" filters. Install first set upon start-up and then install second set when first set is dirty. Dispose of all dirty construction filters. Change filters as often as necessary to keep units from becoming dirty at no additional cost.
 - At substantial completion of the project the entire unit shall be cleaned to present a like "new" unit for the Owner and all filters shall be replaced with new.

- 32.7 For Energy Recovery Units during all phases of construction:
- These units shall not be used for temporary heating and cooling by the Contractor. They shall, however, be made operational, tested, etc. as specified during construction by the Contractor. Three complete sets of filters are required for each unit. In each unit, install one set of filters during construction. In each unit, install one set of filters at substantial completion. For each unit, leave third set of filters in boxes in appropriate mechanical room as a spare set for the Owner. Dispose of all construction filters.
 - At substantial completion of the project the entire unit shall be cleaned to present a like “new” unit for the Owner and all filters shall be replaced with new.

PART 33 – NOISE, VIBRATION OR OSCILLATION:

- 33.1 All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Engineer. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor at their expense.
- 33.2 All equipment subject to vibration and/or oscillation shall be mounted on vibration supports whether indicated or not suitable for the purpose of minimizing noise and vibration transmission, and shall be isolated from external connections such as piping, ducts, etc. by means of flexible connectors, vibration absorbers, or other approved means.
- 33.3 Unitary equipment, such as room units, exhaust fans, etc., shall be rigidly braced and mounted to wall, floor or ceiling as required and tightly gasketed and sealed to mounting surface to prevent air leakage and to obtain quiet operation. Flush and surface mounted equipment such as diffusers, grilles, etc., shall be gasketed and affixed tightly to their mounting surface.
- 33.4 The Contractor shall provide supports for all equipment they furnish. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. If strength of supporting structural members is questionable, contact Engineer.

PART 34 – EQUIPMENT/CONTROLS STARTUP & VERIFICATION:

- 34.1 The Contractor and their Subcontractors shall include in the bid to provide equipment and controls startup and verification for ALL Mechanical Systems specified for this project.
- 34.2 A pre-start-up conference shall be held with the Architect, Engineer, Owner, General Contractor, Mechanical Contractor, Electrical Contractor, Controls Contractor, Test and Balance Contractor, and the Manufacturer’s providing startup services. The purpose of this meeting will be discuss the goals, procedures, etc. for start-up.
- 34.3 Specific line-items shall be included on the schedule of values by each Trade for “equipment and controls startup”. These line-item values shall be approved by the Engineer. The Engineer, Owner and the Engineer’s Field Inspector(s) shall closely monitor progress and quality of the equipment and controls startup and may withhold pay requests as deemed appropriate until satisfactorily completed.
- 34.4 Specific startup/verification specifications are included throughout the Mechanical Specifications. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians, not third party contractors, and shall complete and submit start-up reports/checklists. The Contractor shall have appropriate trades on site to correct all deficiencies noted by

the factory representative. For each deficiency noted, documentation of corrective action (including date and time) shall be submitted to the Engineer and Owner. Where factory start-up is not specified for a particular piece of equipment or system, the Contractor shall be responsible to perform start-up. All information shall be completed by the Contractor and submitted to the Owner/Engineer prior to acceptance of the equipment.

- 34.5 The Contractor shall be responsible for completion of System Verification Checklists/Manufacturer's Checklists. Factory startup is required for all HVAC equipment noted. Unless noted otherwise, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians and shall complete and submit start-up reports/checklists. This shall include the following:
- Outside Air Units
 - Variable Frequency Drives
 - Dehumidification Units
 - Energy Recovery Units
 - Air Handling Units
 - Chillers
 - Cooling Towers
 - Boilers
 - Pumps
- 34.6 Except for the specific equipment specified in this Specification Section, the manufacturer's recommended startup procedures and checklists will be acceptable for use in the project. Where "manufacturer" startup is not specified, then this Contractor shall perform startup services in strict accordance with manufacturer's instructions. All startup/verification process shall be thoroughly documented by the Contractor and shall include the time and date when performed.

PART 35 – INSPECTION, APPROVALS AND TESTS:

- 35.1 Before requesting a final review of the installation from the Architect and/or Engineer, each Contractor shall thoroughly inspect their installations to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineer for unnecessary and undue work on their part.
- 35.2 The Contractor shall provide as a part of this Contract any required Agency inspection, licensed and qualified to provide such services. All costs incidental to the provisions of inspections shall be borne by the Contractor.
- 35.3 The Contractor shall advise each Inspecting Agency in writing, with an informational copy of the correspondence to the Architect and/or Engineer, when they anticipate commencing the work. Inspections shall be scheduled for rough-in as well as finished work. The rough-in inspections shall be divided into as many inspections as may be necessary to cover all rough-in without fail. Failure of the Inspecting Agency to inspect the work in a timely manner and submit the related reports may result in the Contractor having to expose concealed work not so inspected. Such exposure will be at the expense of the responsible Contractor.
- 35.4 Approval by an Agency Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these Plans and Specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
- 35.5 Before final acceptance, the Contractor shall furnish the original and three (3) copies of the certificates of final approval by the Agency Inspector to the Engineer with one copy of each to the appropriate

government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.

PART 36 - ABOVE-CEILING AND FINAL PUNCH LISTS:

- 36.1 The Contractor shall review each area and prepare and complete their own punch list for each of the subcontractors as required for the Project Schedule.
- 36.2 Seven (7) days notice shall be given to the Engineer for review of above ceiling work that will be concealed by tile or other materials. Seven (7) days notice shall be given to the Engineer for review of below ceiling work and final inspection.
- 36.3 When all work from the Contractor's punch list is complete at each of the major Project Stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing seven (7) days prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review. The Contractor's representative may be requested at the inspections.
- 36.4 If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due net 10 days from date of each additional visit) at a rate of \$125.00 per hour plus travel expense for extra trips required to complete either of the above ceiling, below ceiling or final punch lists.

PART 37 – OPERATING INSTRUCTIONS:

- 37.1 Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating the systems and equipment for a period of three (3) days of eight (8) hours each, or as otherwise specified. Refer to Section HVAC EQUIPMENT for additional requirements. During this period, instruct the Owner or their representatives fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least seven (7) days written notice to the Owner, Architect and Engineer in advance of this training period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representatives that were present.
- 37.2 Each Contractor shall furnish three complete bound sets for approval to the Engineer instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft form, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions. Refer to Specification Section SHOP DRAWINGS for additional detail.
- 37.3 Each Contractor, in the above mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.

PART 38 – RECORD DRAWINGS:

- 38.1 The Contractor shall ensure that any deviations from the Design are as they occur recorded in red, erasable pencil on record drawings kept at the jobsite. The Engineer shall review the record documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of under floor sanitary and water lines, shut-off valves, cleanouts and other appurtenances important to the maintenance and operation of Mechanical Systems. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set

of drawings set aside at the job site especially for this purpose and deliver to the Engineer upon completion of the work.

PART 39 - COMMISSIONING: CONTRACTOR RESPONSIBILITIES:

- 39.1 Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
- Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 - Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 - Attend commissioning team meetings.
 - Integrate and coordinate commissioning process activities with construction schedule.
 - Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority.
 - Review and accept commissioning process test procedures provided by the Commissioning Authority.
 - Complete commissioning process test procedures.

PART 40 – COORDINATION DRAWINGS:

- 40.1 Detailed electronic coordination drawings shall be required for this project. A specific line-item shall be included on the schedule of values by each Trade for “preparation of coordination drawings”. This line-item value shall be approved by the Engineer. The Engineer and the Engineer’s Field Inspector shall monitor progress of the preparation of the electronic coordination drawings and may withhold pay requests as deemed appropriate. Coordination drawings are a tool for the Contractor and will not be reviewed by the Engineer unless the Contractor has specific questions. The Engineer will not review or approve the Contractor’s coordination drawings. They are a tool for the Contractor.
- 40.2 Coordination Drawings shall be provided on this project by each Trade. Drawings shall be 30x42 sheet size and shall be at 1/4” scale and shall match the drawing setup as included in the Architectural Drawings. Drawings shall be prepared in electronic format. The Architect and Engineer will supply electronic drawings files of the Contract Documents upon the Contractor’s request and release.
- 40.3 The basis for the Coordination Drawings shall be the sheet metal ductwork fabrication shop drawings, all electrical feeder conduits and other conduits 2” and larger, and any gravity drainage systems and components in ceiling spaces. The Coordination Drawings shall be prepared by the Mechanical Contractor. The Coordination Drawings shall indicate (1) systems above ceilings in finished areas, (2) systems supported from the structure in finished areas without ceilings, (3) systems in the mechanical rooms, and (4) all wall, roof, floor penetrations. These drawings shall indicate all ductwork as double lined with bottom elevations noted.
- 40.4 The sheet metal fabrication shop drawings shall be completed in a timely manner so as not to conflict with construction schedule and phasing plan. At the Prime Contractor’s discretion, these drawings shall be completed in phases to correspond with the project construction work sequencing. The Mechanical Contractor shall furnish an electronic copy of these ductwork shop drawings to all other Trades, specifically the Fire Protection and Electrical and other Contractors as requested by the Prime Contractor for the purpose of including other trades work on the Coordination Drawings.
- 40.5 Pre-Coordination Meetings with all necessary trades shall occur. During these meetings, the Contractors shall discuss locations/elevations where piping, conduits, cable path, etc will be installed with respect to the sheetmetal fabrication drawings and other trades. The sheetmetal ductwork and gravity piping systems shall be given the first priority. Each Trade shall provide the Mechanical Contractor electronic drawings of all of their systems (with elevation noted), coordinated with the ductwork and other trades for them to

incorporate into the Coordination Drawings. Coordination Meetings shall then occur so that all conflicts can be resolved between Trades. All conflicts shall be resolved between all Trades at these Coordination Meetings and the Mechanical Contractor shall then amend the Drawings to include the Final Coordinated Work.

- 40.6 It is realized that not all systems can be completely detailed. The coordination drawings shall include the following at a minimum:
- All supply/return/exhaust ductwork.
 - HVAC, piping which are 1.5” in size and greater, excluding insulation.
 - Electrical conduits which are 1.5” in size and greater.
 - Bridal ring paths.
 - Multiple smaller piping/conduits hung on a common trapeze hanger.
 - All wall, roof, floor penetrations.
- 40.7 After completion of the Final Coordination Drawings, a Final Review with the all Trades shall occur to provide any final comments and approval by all Trades. Other interim coordination meetings will be required to ensure successful coordination drawings. Any additional coordination items will be updated by the Mechanical Contractor. The Final Approved Coordination Drawings shall be distributed electronically to each Trade by the Mechanical Contractor. The Mechanical Contractor shall also furnish a complete 30x42 paper set of drawings to the jobsite main office and shall utilize them for updates of field conditions/deviations that occur during construction. Final Approved Coordination Drawings shall also be distributed to the Prime Contractor, Owner, Architect and Engineer for their Records. This process shall be completed prior to starting any work.
- 40.8 Each Contractor shall ensure that any deviations from the Coordination Drawings are recorded as they occur, in red erasable pencil on Coordination Drawings kept at the jobsite. Upon completion of a particular phase, the Mechanical Contractor shall incorporate all field deviations into the Coordination Drawings to be utilized as Record Drawings. The Engineer shall review the Record Documents from time to time to ensure compliance with this specification. Compliance shall be a contingency of final payment. Pay particular attention to the location of under floor sanitary and water lines, shut-off valves, cleanouts and other appurtenances important to the maintenance and operation of Mechanical Systems. Also, pay particular attention to Deviations in the Control Systems and all exterior utilities. Keep information in a set of drawings set aside at the job site especially for this purpose. The Record Drawings shall be distributed electronically to the Prime Contractor, Owner, Architect and Engineer for their Records.
- 40.9 The mechanical contractor is responsible to the general contractor for the shop drawing layout of the following rooms and details:
- Concrete pads and foundations
 - Equipment room layouts with actual equipment
 - Roof layouts
 - Trench locations and sizes
 - Dimensioned floor drain locations
 - Congested areas above ceilings adjacent to mechanical and electrical room
 - Dimensioned ductwork shop drawings
- 40.10 The electrical contractor is responsible to the general contractor for the shop drawing layout of the following rooms and details:
- Concrete pads and foundations
 - Equipment room layouts with actual equipment
 - Routes of feeders conduits and all other conduits 1.5” and larger
 - Bridle ring cabling paths
 - Trench locations and size
 - Congested areas above ceilings adjacent to mechanical and electrical rooms

- 40.11 The contractor's final coordination drawings shall be coordinated with actual field conditions, as examined and verified by the contractor following completion of demolition. The contractor shall complete coordination drawings in phases as required to accommodate sequencing of construction, shop drawing review and approval, etc. as required for the contractor to maintain the construction schedule.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 200200 - SCOPE OF THE MECHANICAL WORK

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS – MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Mechanical work for this Contract shall include all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, place in service and deliver to the Owner the complete mechanical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not necessarily limited to the following paragraphs.
- 1.3 All applicable services and work specified in GENERAL PROVISIONS - MECHANICAL.
- 1.4 Installation of all equipment per the manufacturer's instruction, whether specifically detailed or not.
- 1.5 Removal of the existing chillers, boilers, and pumps and installation of new chillers, cooling towers, boilers, and pumps.
- 1.6 Removal of existing pool air handling units and installation of new outside air unit and dehumidification units.
- 1.7 Extension of area C supply ductwork, hot water piping, and transfers to classrooms on front exterior of building and additional of VAV boxes serving these areas.
- 1.8 Removal of all steam and condensate piping and equipment.
- 1.9 Removal of existing Area C air handling unit and installation of new air handling unit and energy recovery unit.
- 1.10 Replacement of existing Area C variable air volume boxes.
- 1.11 Provide all required motor starters, etc. not provided under the electrical sections.
- 1.12 Thorough instruction of the Owner's maintenance personnel in the operation and maintenance of all mechanical equipment.
- 1.13 Thorough coordination of the installation of all piping, ductwork, equipment and any other material with other trades to ensure no conflict in installation.
- 1.14 Approved supervision of the mechanical work.
- 1.15 Procurement of all required inspections, including fees for all inspection services and submission of final certificates of inspection to the Engineers.
- 1.16 Cutting, patching, sleeving, concrete work, etc., required to construct the mechanical systems.
- 1.17 Equipment and controls start-up, verification and documentation as specified.

- 1.18 Record drawings, final inspection certificates, test results, O & M documentation, warranty certification, spare parts and other specified closeout documentation.
- 1.19 Required schedule of values breakdown.
- 1.20 Pipe, duct and equipment identifications.
- 1.21 Preinstallation meetings and equipment mockups.
- 1.22 Complete exterior natural gas system connected to the local system/utility.
- 1.23 Domestic hot, cold and recirculating hot water system.
- 1.24 Soil, waste and vent systems.
- 1.25 All plumbing equipment, fixtures and fittings.
- 1.26 Specified Commissioning activities.
- 1.27 All mechanical exhaust systems.
- 1.28 All insulation associated with mechanical systems.
- 1.29 Condensate drainage systems.
- 1.30 All required pressure testing, flushing, purging, pressure and flow testing requirements.
- 1.31 All required controls, including self checkout and commissioning.

END OF SECTION.

DIVISION 20 - MECHANICALSECTION 200300 - SHOP DRAWINGS, MAINTENANCE MANUALS AND PARTS LISTSPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS – MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall prepare and submit to the Engineer, through the Prime Contractor and the Architect within thirty (30) days after the date of the Contract, required copies of all shop drawings, certified equipment drawings, installation, operating and maintenance instructions, samples, wiring diagrams, etc. on all items of equipment specified hereinafter. Refer to Division 1 requirements for shop drawing submittal requirements.
- 1.3 Provide all shops in electronic/PDF format. The Engineer's comments will be returned in electronic format.
- 1.4 Each shop drawing and/or manufacturers descriptive literature shall have the proper notation indicated on it selecting equipment, accessories and features and shall be clearly referenced to the specifications, schedules, fixture numbers, etc., so that the Engineer may readily determine what the Contractor proposes to furnish. All data and information schedules indicated or specified shall be noted on each copy of each submittal.
- 1.5 Submittal data shall include specification data including metal gauges, finishes, accessories, etc. Also, the submittal data shall include certified performance data, wiring diagrams, dimensional data, and a spare parts list. Submittal data shall be reviewed by the Engineer before any equipment or materials is ordered or any work is begun in the area requiring the equipment.
- 1.6 All submittal data shall have the stamp of approval of the Contractor submitting the data as well as the Prime Contractor and the Architect to show that the drawings have been reviewed by the Contractor. Any drawings submitted without these stamps of approval may not be considered and will be returned for proper resubmission.
- 1.7 The Contractor shall make any corrections or changes required by the Engineer and shall re-submit for final review as outlined above.
- 1.8 It shall be noted that review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the Contract Documents. In all cases, the Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located. The Contractor shall also coordinate piping side connections.
- 1.9 The Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for adaptability of the item to the project; compliance with applicable codes, rules, regulations and information that pertains to fabrication and installation; dimensions, weight and quantities; electrical characteristics; and coordination of the work with all other trades involved in this project.
- 1.10 Prior to ordering any materials or rough-in of any kind, the Mechanical Contractor shall be responsible for final coordination of all electrical requirements (i.e. voltage, phase, circuit breaker, wire sizing, etc.) with

the Electrical Contractor. There will be no change in the Contract Amount for any discrepancies. A final coordination meeting shall be held with the Architect, Owner, Engineer, Prime Contractor, Mechanical Contractor, Electrical Contractor and their sub-contractors.

- 1.11 Equipment shall not be ordered and no final rough-in connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractor. It shall be the Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. The Contractor shall coordinate with all the other trades having any connections, roughing-in, etc. to the equipment.
- 1.12 If the Contractor fails to comply with the requirements set forth above, the Engineer shall have the option of selecting any or all items listed in the Specifications or on the Drawings; and the Contractor shall be required to furnish all materials in accordance with this list.
- 1.13 Colors for equipment in other than mechanical spaces shall be selected from the Manufacturer's standard and factory optional colors unless noted otherwise on the Plans. Color samples shall be furnished with the shop drawing submission for such equipment.
- 1.14 All submittals for mechanical equipment shall include all information specified and scheduled. This shall include air and water pressure drops, RPM, noise data, face velocities, horsepower, voltage motor type, steel or aluminum construction, and all accessories clearly marked.
- 1.15 All items listed in the schedules shall be submitted for review in a tabular form similar to the equipment schedule. All items submitted shall be designated with the same identifying tag as specified on each sheet.
- 1.16 Any submittals received in an unorganized manner without options to be provided specifically noted and with incomplete data will be returned for resubmittal.

PART 2 – SHOP DRAWINGS:

- 2.1 Shop Drawings, descriptive literature, technical data and required schedules shall be submitted on the following:

- Access Doors
- Air Filtration & Components
- Air Handling Units
- Chemical Treatment and Test Reports
- Ductwork Accessories/Volume Dampers
- Firestopping (2.2.3)
- Floor Drains
- High Velocity Ductwork & Fittings
- Insulation
- Plumbing Fixtures, Fittings and Trim
- Plumbing Specialties
- Outside Air Handling Units
- Dehumidification Units
- Energy Recovery Units
- Chillers
- Cooling Towers
- Boilers
- Hydronic Pumps
- Hydronic Specialties
- Register, Grilles, Diffusers and Louvers
- System Verification Check Lists

Temperature Controls & Components (2.2.2)
Valves
Variable Frequency Drives
VAV Air Terminals
Water Heaters
Water Softeners
Unit Heaters
Exhaust Fans

(Refer to the corresponding Special Notes.)

2.2 SPECIAL NOTES:

- 2.2.1 For all items above, upon substantial completion of the project, the Contractor shall deliver to the Engineer (in addition to the required Shop Drawings) three (3) complete copies of operation and maintenance instructions and parts lists for each item above. Where available, documents shall include at least:
- Detailed operating instructions
 - Detailed maintenance instructions including preventive maintenance schedules.
 - Addresses and phone numbers indicating where parts may be purchased.
 - Expanded parts drawings, parts lists, service manuals, schematics, wiring diagrams.
 - Master air filter list including equipment identification, filter size, filter quantity, and supplier contact information.
 - Start-up reports, service records and test reports.
- 2.2.2 Shop drawings for the Temperature Control Systems shall include detailed, scaled plans and schematic diagrams indicating the function and operation of the system. Refer to Specification Section – CONTROLS for additional requirements.
- 2.2.3 The Contractor shall submit project specific UL listed firestopping installation drawings to the authority having jurisdiction where required for their approval as required.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 200400 - DEMOLITION

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 2.1 It is the intent of this Section to completely remove all components of any existing mechanical system indicated in the mechanical drawings and items associated with the required architectural demolition specified in the Contract Documents. Also, any mechanical systems that will be open to view, or will interfere with the operations of the completed building, or which will, in any way, interfere with project construction shall be removed. The Contractor shall field verify existing conditions prior to bid.

PART 2 – PLUMBING DEMOLITION:

- 2.1 The general scope of the plumbing system demolition is indicated on the drawings. Where plumbing fixtures, equipment, etc. are removed, also remove all associated branch piping, hangers, insulation, concrete pads, controls, etc. Where plumbing fixtures are removed, all piping and services shall be removed in accordance with the current Building Code.
- 2.2 Refer to the demolition drawings for piping which shall be demolished or shall remain. If other piping is found during construction which is not indicated on the drawings, the fixtures the piping serves must be identified. If it serves fixtures which are being demolished, the piping shall be removed back to the nearest mains and capped. Verify this work with the Engineer prior to demolition.
- 2.3 The Contractor shall be responsible for the removal and/or relocation of any plumbing equipment, concrete pads, piping, drain lines, vent lines, valves, fittings, etc., which may in the course of construction, interfere with the installation of any new and/or relocated Architectural, Mechanical or Electrical Systems specified in the Contract Documents. This work shall be performed at no increase in the contract price.
- 2.4 Unless otherwise indicated, the Contractor shall be responsible for patching and repairing by all qualified tradesmen, all holes, etc. in the ceilings, walls, roof and floors where plumbing equipment is removed.
- 2.5 All underslab pipes abandoned in place shall be made safe in compliance with the Plumbing Code. Above slab piping is not allowed to be abandoned and must be removed.
- 2.6 All plumbing equipment not indicated to be reused shall be removed.

PART 3 – HVAC DEMOLITION:

- 3.1 The general scope of the HVAC system demolition is indicated on the drawings. Where HVAC units are removed, also remove all associated ductwork, branch piping, hangers, insulation, controls, etc.
- 3.2 Refer to the demolition drawings for equipment, piping and ductwork to be demolished or which shall remain. If other equipment, piping or ductwork is found during construction which is not indicated on the drawings, it must be determined if these systems serve other areas not being renovated. If the equipment piping and ductwork serve only renovated areas, the system shall be demolished. Verify this work with the Engineer prior to demolition.

- 3.3 Remove all temperature controls, panels, accessories, etc. that are accessible or become accessible during construction that serves demolished systems. Remove all pneumatic control tubing, control wiring and conduits in the facility unless noted otherwise.
- 3.4 The Contractor shall be responsible for the removal and/or relocation of any HVAC piping, equipment, fittings, valves, etc. which may, in the course of construction, interfere with the installation of any new and/or relocated Architectural, Structural, Mechanical or Electrical Systems specified in the Contract Documents at no increase in the contract price.
- 3.5 Unless otherwise indicated, the Contractor shall be responsible for the patching and repairing by qualified tradesmen of all holes, etc. in the ceiling, wall, roof and floors where HVAC equipment is removed.
- 3.6 Where piping and ductwork systems are partially demolished, cap systems air and water tight and insulate. All capping of duct systems shall be completed with 22 gauge sheet metal and insulated. Seal with duct sealant.

END OF SECTION.

DIVISION 20 - MECHANICALSECTION 201100 - SLEEVING, CUTTING, PATCHING, REPAIRING AND FIRESTOPPINGPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS – MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall be responsible for all openings, sleeves, trenches, etc., that may be required in floors, roofs, ceilings, walls, etc., and shall coordinate all such work with the General Contractor and all other trades. Coordinate with the General Contractor, any openings which they are to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the Contractor.
- 1.3 The Contractor shall plan their work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for piping, ductwork, conduit, etc., to route through; however, when this is not coordinated, the Contractor shall then do all cutting and patching required for the installation of their work, or pay other trades for doing this work when so directed by the Engineer. Any damage caused to the building by this Contractor shall be corrected or rectified at their expense.
- 1.4 The Contractor shall notify other trades in due time where they will require openings or chases in new concrete, masonry, etc. Set all concrete inserts and sleeves for their work. Failing to coordinate, Contractor shall cut openings for the work and patch same as required at their expense with qualified tradesman.
- 1.5 The Contractor shall be responsible for properly shoring, bracing, supporting, etc., any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements shall be promptly and properly corrected to the satisfaction of the Engineer.
- 1.6 All work improperly performed or not performed as required in this section, shall be corrected by the General Contractor at the responsible Contractor's expense.

PART 2 – SLEEVES:

- 2.1 Cast iron or Schedule 40 steel sleeves shall be installed through all walls where pipe enters the building below grade. Sleeves shall be flush with each face of the wall and shall be sufficiently larger than the entering pipe to permit thorough caulking between pipe and sleeve for water proofing. Horizontal sleeves passing through exterior walls or where there is a possibility of water leakage and damage shall be caulked watertight. Utilize "Link-Seal" at these locations.
- 2.2 In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter plus insulation. Sleeves through walls and floors shall be cut off flush with inside surface unless otherwise indicated.
- 2.3 Vertical sleeves in roofs shall be flashed and counterflashed with lead (4 lb.) or 16 oz. copper and welded or soldered to piping, lapped over sleeve and properly weather sealed. Where sleeves pass through roof construction, sleeves shall extend minimum of 12" above the roof.

- 2.4 Cast iron or Schedule 40 steel sleeves shall be installed through all walls where pipe enters the building below grade. Sleeves shall be flush with each face of the wall and shall be sufficiently larger than the entering pipe to permit thorough caulking between pipe and sleeve for water proofing. Horizontal sleeves passing through exterior walls or where there is a possibility of water leakage and damage shall be caulked watertight. Utilize "Link-Seal" at these locations.
- 2.5 Provide pipe sleeves through all interior wall penetrations. Sleeve shall be cast iron or schedule 40 steel. In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter plus insulation. Sleeves through walls and floors shall be cut off flush with inside surface unless otherwise indicated. Reference Part 5 for firestopping requirements in rated walls. Sleeves and annular space between pipe and sleeve in non-rated walls shall be sealed completely with acoustical non-shrink caulk.
- 2.6 Vertical sleeves in roofs shall be flashed and counterflashed with lead (4 lb.) or 16 oz. copper and welded or soldered to piping, lapped over sleeve and properly weather sealed. Where sleeves pass through roof construction, sleeves shall extend minimum of 12" above the roof.

PART 3 – CUTTING:

- 3.1 All openings in plaster, gypsum board or similar materials, shall be framed by means of plaster frames, casing beads, or angle members as required. The intent of this requirement is to provide smooth, even termination of wall, floor and ceiling finishes as well as to provide a fastening means for devices, etc.
- 3.2 The Mechanical Contractor shall coordinate all openings in masonry walls with the General Contractor; and, unless otherwise indicated in the Contract Documents, shall provide lintels for all openings required for the mechanical work such as louvers, exhaust fans, etc. Prime paint all lintels. Lintels shall be sized as follows: Unless noted otherwise in the Structural Drawings.
- 3.2.1 New Openings under 48" in width: Provide one 3½"x3½"x3/8" steel angle for each 4" of masonry width. Lintel shall have 8" bearing on each end.
- 3.2.2 New Openings over 48" in width: Consult with Structural Engineer.
- 3.3 No cutting shall be performed at location that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.
- 3.4 Pipe openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe-cut with a masonry saw.

PART 4 – PATCHING, REPAIRING AND FINISHING:

- 4.1 Patching and repairing made necessary by work performed under this Division shall be included as a part of the work and shall be done by skilled workers of the trade. The work shall be performed in strict accordance with the provisions herein before specified to match adjacent surfaces and in a manner acceptable to the Engineer.
- 4.2 Where portions of existing sites, lawns, shrubs, paving, etc. are disturbed for installation of work of this Division, such items shall be repaired and/or replaced back to original or better condition to the satisfaction of the Engineer.
- 4.3 Piping and ductwork passing through floors, ceilings and walls in finished areas shall be fitted with chrome plated brass escutcheon trim pieces of sufficient outside diameter to amply cover the sleeved openings and an inside diameter to closely fit the pipe/duct around which it is installed.
- 4.4 Flanged metal collars shall be provided around all ducts, flues, pipes, etc. at all wall penetrations; both

sides. Penetrations through any wall will require the installation of flanged collars. Openings shall not be any larger than 2" in any direction than the piping/duct passing through the wall. Openings larger than this requirement shall also be infilled to match adjacent construction. Fill void with insulation for sound reduction.

PART 5 – FIRESTOPPING:

- 5.1 Provide shop drawings indicating penetration detail for each type of wall and floor construction. Shop drawings must be specific for each individual type of penetration (one hour fire rated gypsum wall board with insulated metal pipe penetration, etc.) Provide copies to the authority having jurisdiction if required.
- 5.2 All mechanical pipes and ducts penetrating fire rated floors and walls shall be firestopped by this Contractor. All firestopping products and assemblies installed shall be UL listed.
- 5.3 Where the installation of conduit, ducts, piping, etc. requires the penetration of fire or smoke rated walls, ceilings or floors, the space around such conduit, duct, pipe, etc., shall be tightly filled with an approved non-combustible fire insulating material and properly sealed to maintain the rating integrity of the wall, floor or ceilings affected.
- 5.4 Where the installation of ductwork requires the penetration of non-rated floors, the space around the duct or pipe shall be tightly filled with an approved non-combustible material.
- 5.5 The manufacturer of the firestopping materials shall provide on site training for the installing Contractor. The training session shall demonstrate to the Contractor the proper installation techniques for all the firestopping materials.
- 5.6 Firestopping materials include (but are not limited to) wraps, strips, caulks, moldable putties, restricting collars with steel hose clamps, damming materials, composite sheets, fire dam caulks, steel sleeves, etc.
- 5.7 The following indicates the 3M penetration details for uninsulated pipe penetration of various wall and floor construction types (the list is not inclusive):
 - One, two or three hour fire rated concrete floor - 3M #5300-MPC8.
 - One, two or three hour fire rated solid or block concrete wall - 3M #5300-MPC16 or 3M #5300-MPC26.
 - One hour fire rated gypsum wallboard - 3M #5300-MPC7.
 - Two hour fire rated gypsum wallboard - 3M #5300-MPC7.
- 5.8 The following indicates the 3M penetration details for insulated pipe penetrations of various wall and floor construction types (the list is not inclusive):
 - One, two and three hour fire rated concrete floor - 3M #5300-IMP2.
 - One, two and three hour concrete block wall - 3M #5300-IMP2.
 - One hour fire rated gypsum wallboard - 3M #5300-IMP4.
 - Two hour fire rated gypsum wallboard - 3M #IMP7.
- 5.9 HVAC ducts penetrating a one or two hour fire rated wall or floor shall be firestopped per 3M #5300-HVD1.
- 5.10 Multiple pipes penetrating fire rated floors and walls may be firestopped as a group. Submit details for specific applications if this method of firestopping is chosen.

END OF SECTION.

DIVISION 20 - MECHANICALSECTION 201200 - EXCAVATION, TRENCHING, BACKFILLING AND GRADINGPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall include all excavating, filling, grading, and related items required to complete their work as shown on the drawings and specified herein or as required to complete, connect and place all mechanical systems in satisfactory operation.

PART 2 – EARTHWORK CLASSIFICATION:

- 2.1 Without regard to the materials encountered, all excavation and materials excavated shall be unclassified. Materials to be excavated shall include earth, rock, concrete or any other obstructions encountered in excavation and/or trenching to install underground utility pipes, tanks, vaults or other equipment.
- 2.2 Include all costs for rock removal, including mass rock and trench rock in the bids. No adjustment in the contract sum will be made on account of the presence or absence of rock, shale, debris, obstructions or other materials encountered in the excavating. The Contractor shall be responsible for the removal of all materials encountered as required for the installation of the work.
- 2.3 It shall be distinctly understood that references to rock, earth, topsoil or any other excavated or non-excavated material or other material on the construction plans, cross section, contract documents, technical specification or provisions, whether in numbers, words, letters, lines or graphically shown, is solely for information for the Engineer and Owner. This information shall not be taken as an indication of the classification of the material to be excavated, bored or removed by any method, including drilling and blasting, or materials not removed. This information shall not be taken as to the quantity of either rock, earth, topsoil, or any other material involved, or the quality of the material such as hardness, wetness, workability or suitability of the material either during excavation and construction or as a material to be reused during construction.
- 2.4 The Contractor shall draw their own conclusions as to the surface and sub-surface conditions to be encountered during construction of this project. The Engineer and Owner do not give any guarantee or warranty as to the accuracy of the data shown and no claim will be considered for additional compensation when the materials encountered are not in accord with the information shown.
- 2.5 Refer to Specification Division EARTHWORK located in the Site Work portions of the Specifications and Civil Drawings for additional information. Also refer to the GEOTECHNICAL report (provided for informational purposes only) included in the Front End of the Specifications.

PART 3 – EXCAVATION:

- 3.1 Unless otherwise shown or required, provide separate trenches for sewers, water lines and other underground raceways, with a minimum of 10 feet measured from outside diameter between pipes. In locations, such as close to buildings where separate trenches for sewers and water lines are impractical, lay the water pipe on a solid shelf at least 2'-0" above the top of the sewer and 2'-0" to the side.
- 3.2 Water lines crossing under sewer lines, or crossing less than 2 feet above sewer lines, must be concrete encased for a distance not less than 5 feet on either side of the point of crossover.

- 3.3 Excavate trenches of sufficient width for proper installation of the work. Excavate to 6" below the bottom of new pipes for installation of compacted fill.
- 3.4 Sheet and brace trenches as necessary to protect workers and adjacent structures. Comply with local regulations or, in the absence thereof, with the latest version of "Manual of Accident Prevention in Construction" by the Associated General Contractors of America and current OSHA Standards. Do not remove sheeting until trench is backfilled sufficiently to protect pipe and/or equipment and prevent injurious caving. Where removal of sheeting and/or bracing is hazardous, leave in place. Cut off such sheeting not to be removed at least 3 feet below finished grade.
- 3.5 Rules and regulations governing the respective utilities shall be observed in executing all work under this Division. Active utilities discovered in the course of excavation shall be protected or relocated in accordance with written instructions from the Engineer. Inactive and abandoned utilities encountered in trenching operations shall be removed and abandoned with ends plugged or capped in accord with current codes and safe practice. If in doubt, contact Engineer.
- 3.6 Machine excavation shall not be allowed within ten (10) feet of electric lines, natural gas lines or other lines carrying combustible materials. Use only hand tool excavation methods.
- 3.7 The removal of rock shall be accomplished by use of hand or power tools only. Blasting shall not be permitted. Any damage to existing structures, piping services, or rock intended for bearing, shall be corrected at the responsible Contractor's expense.
- 3.8 Perform final grading of trench bottoms by hand tools; carry machine excavation only to such depth that soil bearing for pipes and raceways will not be disturbed. Grade the bottom of trenches evenly to ensure uniform bearing for all piping and raceways. Cut bell holes as necessary for joints and jointmaking. Except as hereinafter specified, bottom of trenches for bell and spigot pipe, flanged pipe, etc. shall be shaped to the lower quadrant of pipe with additional excavation for bell or flange. Piping installed where it rests on bell or flange and/or is supported with blocks or wedges will not be accepted.
- 3.9 Keep trenches free from water while construction is in progress. Under no circumstances lay pipe or appurtenances in water. Pump or bail water from bell holes to permit proper joining of pipe. Any dewatering from this Contractor's trenches which is required during construction, shall be included in this Contract.
- 3.10 In no case shall excavation work be accomplished that will damage in any way the new structure, existing structures, equipment, utility lines, landscaping to remain, etc. The Contractor shall take the necessary steps to prevent flow of eroded earth by water or landslide onto the property of others, or against the structures. The repair of all such damage or any other damage incurred in the course of excavation shall be at the responsible Contractor's expense.
- 3.11 Use surveyor's level to establish elevations and grades.
- 3.12 Machine excavation shall be held a sufficient distance from foundations and footings to ensure no damage to same. Contractor shall accept full responsibility and pay for repairs and/or replacement of structural members, footings, etc.
- 3.13 The Contractor shall accept the site as it is. Remove all trash, rubbish and unsuitable material from the site at the completion of excavation work.
- 3.14 The Contractor shall provide and maintain barricades, trench plates and temporary bridges around excavations as required for safety. Temporary plates or bridges shall be provided where excavations cross paved areas and walks. The Contractor shall maintain these plates and bridges in a safe and passable

condition for all traffic until removal. Refer to OSHA Standards for such installations and comply with same in all details.

- 3.15 Pay particular attention to existing utilities and lines to avoid damage. The locations of existing lines which are indicated on the plans were taken unconfirmed from drawings prepared for previous construction and locations are approximate only. Also, certain water, gas, electric, storm and sanitary sewer lines and other underground appurtenances, active or abandoned, may not appear on the drawings. It shall be each Contractor's responsibility to ascertain the location of all lines and excavate with caution in their area.
- 3.16 Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.
- 3.17 Maintain carefully all bench marks, monuments and other reference points. If disturbed or destroyed, replace as directed.

PART 4 – BACKFILL, COMPACTION AND SURFACE REPAIR:

- 4.1 Backfilling for Mechanical Work shall include all trenches, manhole pits, tanks and/or any other earth and/or rock openings which are excavated under this Contract. Backfilling shall be carefully performed and the surface restored to its original level to receive new finish. Wherever trenches and earth openings have not been properly filled and/or settlement occurs, they shall be re-excavated, re-filled and properly compacted, smoothed off and finally made to conform to the level of the original ground surface.
- 4.2 All trenches shall be backfilled with a bedding of 6" of manufactured sand or #8 crushed stone after finished excavation. Install the new pipe on the compacted fill material. Install tracer wire on all pipe. Apply any special coatings to the pipe. Also perform all required pressure tests and check the grade of the pipe to ensure that it is correct and free of swags, bows or bends. Once coatings and testing are complete, backfill the pipe bed to 12" above the top of the pipe with specified compacted fill material. Backfill the remainder of the trench with earth (rock and debris free) tamped at 6" intervals. Water settling of backfill is permitted only as an aid to mechanical compacting.
- 4.3 Backfill and compact beneath areas to be seeded or sodded within six (6) inches of finished grade. The remaining six (6) inches shall be backfilled with clean top soil.
- 4.4 Backfill and compact beneath concrete slabs, paved areas, walks, etc. shall be brought to proper grade to receive the sub-base, concrete slab or paving. No concrete or paving shall be placed on uncompacted fill or unstable soil.
- 4.5 Wherever, in the opinion of the Engineer, the soil at or below the requisite pipe grade is unsuitable for supporting piping, special support shall be provided as directed by the Engineer.
- 4.6 Backfill and compaction for natural gas lines shall be in strict accordance with the local utility company or local municipality's requirements. If in doubt, contact the utility company or local municipality.
- 4.7 Unsuitable material and surplus excavated material not required for backfill shall be removed from the site. The location of dump and length of haul shall be the affected Contractor's responsibility.
- 4.8 Provide and place any additional fill material from off the site as may be required for backfill. Fill obtained from offsite shall be of kind and quality as specified for backfill and the source approved by the Engineer and shall be brought to the site by the Contractor requiring the fill.

- 4.9 If not specified or indicated elsewhere in the Contract Documents to be performed by Others, the Contractor shall lay new sod over their excavation work for existing disturbed grassy areas. Level, with adjacent surface, compact and water in accord with sound sodding practice.
- 4.10 Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated in the following two paragraphs.
- 4.11 At a minimum, fill in grass areas shall be compacted to 90% Standard Proctor Density, ASTM D-698, at moisture content between 2 percent below to a 3 percent above the optimum moisture content or as specified in Specification Division EARTHWORK; whichever is most stringent.
- 4.12 At a minimum, fill in concrete or asphalt area shall compacted to 98% Standard Proctor Density, ASTM D-698, at moisture content between 2 percent below to a 3 percent above the optimum moisture content or as specified in Specification Division EARTHWORK; whichever is most stringent.
- 4.13 Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.
- 4.14 All materials used for backfill around structures shall be of a quality acceptable to the Engineer and shall be free from large or frozen lumps, large rocks, wood, and other extraneous material. All spaces excavated and not occupied by footings, foundations, walls or other permanent work shall be refilled with earth up to the surface of the surrounding ground, unless otherwise specified, with sufficient allowance for settlement.
- 4.15 In making the fills and terraces around the structures, the fill shall be placed in layers not exceeding 8 inches in depth and shall be kept smooth as the work progresses. Each layer of the fill shall be compacted. Sections of the fill immediately adjacent to buildings or structures shall be thoroughly compacted by means of mechanical tamping or hand tamping as may be required by the conditions encountered. All fills shall be placed so as to load structure symmetrically.
- 4.16 Rough grading shall be held below finished grade and then the topsoil which has been stockpiled shall be evenly spread over the surface. The grading shall be brought to the levels as specified. Final dressing shall be accomplished by hand work or machine work, or a combination of these methods as may be necessary to produce a uniform and smooth finish to all parts of the regrade. The surface shall be free from clods greater than one inch in diameter. Excavated rock (1" and smaller) may be placed in the fills, but is shall be thoroughly covered. Rock placed in fills shall not be closer than 24 inches from finished grade. Refer to Specification Division EARTHWORK.
- 4.17 Maintenance Settling: Where settling is measurable or observable at excavated areas during Project Warranty Period, remove surface (pavement, concrete or any other surface or finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration.
- 4.18 Disposal of Excess Non-organic Soil and Rock: Any excess excavated waste material shall become the property of the Contractor and shall be disposed of by the Contractor off site at no additional cost to the Owner.
- 4.19 Unless otherwise directed by the Owner during construction, excess topsoil and subsoil suitable for fill shall be disposed of by the Contractor off site at no additional cost to the Owner.

PART 5 – MINIMUM DEPTHS OF BURY TO TOP OF PIPE:

- 5.1 In the absence of other indication, the following shall be the minimum depth of bury to top of pipe of exterior utility lines. Check drawings for variations.
 - 5.1.1 Domestic Water Lines 36 inches below final grade.
 - 5.1.2 Fire Service Lines 48 inches below final grade.
 - 5.1.3 Storm Lines 24 inches below final grade.
 - 5.1.4 Sanitary Lines 36 inches below final grade.
 - 5.1.5 Natural Gas Lines 36 inches below final grade.
 - 5.1.6 Condenser Supply 12 inches below final grade.
 - 5.1.7 All Other Lines Not Listed 36 inches below final grade.

END OF SECTION.

DIVISION 20 - MECHANICALSECTION 201300 - PIPE, PIPE FITTINGS AND PIPE SUPPORTPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 Each Contractor's attention is also directed to Specification Section HANGERS, CLAMPS, ATTACHMENTS, ETC.
- 1.3 Unless otherwise indicated, all materials shall be new and of the best grade and quality for the type specified. Materials shall comply with the "Buy American Act".
- 1.4 Where piping is not indicated on the plans, but is obviously or apparently required, contact the Engineer prior to submission of the bid.
- 1.5 All piping shall be capped or plugged during erection as required to keep clean and debris and moisture free.
- 1.6 The piping indicated shall be installed complete and shall be of the size indicated. When a pipe size is not indicated, the Contractor shall request the pipe size from the Engineer. Where a section of piping is not indicated but is obviously required for completion of the system, the Contractor shall provide same at no additional cost to the project.
- 1.7 All piping shall be installed straight and true, parallel or perpendicular to the building construction. Piping shall be installed so as to allow for expansion without damage to the building finishes, structure, pipe, equipment, etc., use offsets, U-bends or expansion joints as required. No mitered joints or field fabricated pipe bends shall be accepted. Pipe shall clear all windows, doors, louvers and other building openings.
- 1.8 All pipes shall be supported in a neat and workmanlike manner and wherever possible, parallel runs of horizontal piping shall be grouped together on hangers. Vertical risers shall be supported at each floor line with approved steel pipe riser clamps. Spacing of pipe supports shall not exceed eight (8) foot intervals for pipes 3" and smaller and ten (10) foot intervals on all other piping. Small vertical pipes (1" and less) shall be bracketed to walls, structural members, etc. at four (4) foot intervals so as to prevent vibration or damage by occupants.
- 1.9 Insulated piping shall be supported on a rigid insulation block at each hanger so as to prevent crushing of insulation by hangers. Hangers shall pass completely around the insulation jacket and a steel protective saddle shall be applied to prevent compression of the insulation. Refer to Specification Section INSULATION - MECHANICAL.
- 1.10 The use of wire or perforated metal to support pipes will not be permitted. Hanging pipes from other pipes shall not be permitted.
- 1.11 In metal buildings or buildings with light gauge trusses, support piping with standard pipe hangers with C-clamp connection to main structural members (not perlines), use angle steel cross pieces between main structural members where required to provide rigid support.
- 1.12 Where piping rests directly on a hanger, clip, bracket or other means of support, the support element shall be of the same material as the pipe, (e.g., copper to copper, ferrous to ferrous, etc.) or shall be electrically

isolated one from the other so as to prevent pipe damage by electrolysis. Pay particular attention and do not allow copper pipe to rest on ferrous structural members, equipment, etc. without electrolytic isolation. This includes temporary support required during Construction.

- 1.13 In general, piping shall be installed concealed except in mechanical rooms, etc. unless otherwise indicated, and shall be installed underground or beneath concrete slabs only where indicated. All lines at ceilings shall be held as high as possible and shall run so as to avoid conflicts with other trades, and to facilitate the Owner's use and maintenance. Location of pipe in interior partitions shall be carefully coordinated with whoever will construct the partitions after the piping is in place. Where exposed risers occur they shall be kept as close to walls as possible.
- 1.14 Pipe shall be cut accurately to measurements established at the building by the Contractor and worked into place without springing or forcing. All pipes shall be reamed to full pipe diameter before joining and before assembling. All lengths of pipe shall be set vertically and tapped with a hammer to remove scale and dust and inspected to ensure that no foreign matter is lodged therein.
- 1.15 All hot and cold water piping shall be kept a sufficient distance apart so as to prevent heat transfer between them. Cold water piping shall also be kept apart from refrigerant hot gas lines.
- 1.16 Piping carrying water or other fluids subject to freezing shall not be installed in locations subject to freezing. If in doubt, consult Engineer.
- 1.17 Pay particular attention to conflict of piping with other work. Do not install until conflict is resolved. If in doubt, consult Engineer.
- 1.18 Piping materials in each system shall, to the extent practicable, be of the same material. Frequent changes of material (for example, from copper to steel) shall be avoided and in no case shall be accomplished without use of insulating unions and permission of the Engineers.
- 1.19 Dielectric couplings or through ways shall be provided at all connections of dissimilar materials.
- 1.20 Nipples shall be of the same material, composition and weight classification as pipe with which installed.
- 1.21 Apply approved pipe dope for service intended to all male threaded joints. The dope shall be listed for intended use.
- 1.22 Eccentric reducers shall be used where required to permit proper drainage and venting of pipe lines; bushings shall not be permitted.
- 1.23 High points of closed loop chilled water and hot water systems shall have manual air vents as required unless automatic air vents are specifically indicated. Pipe to suitable drainage point.
- 1.24 Installation of pipe shall be in such a manner as to provide complete drainage of the system, whether detailed or not on plans. Drain valves shall be provided at all drainage points on pipes. Drain valves shall be ½" size ball valves with ¾" hose thread end and vacuum breaker. Label each drain valve.
- 1.25 Non-metallic piping shall be installed in strict accordance with the manufacturer's instructions. If no such instructions are available, consult Engineer.
- 1.26 When running any type of pipe below a footing, perpendicular to the footing, the area underneath the footing and in the zone of influence shall be backfilled with concrete. The zone of influence is the area within a 45 degree angle projecting down from the top edge of footing on all sides of the footing.

- 1.27 When running any type of pipe below a footing, parallel to the footing, the area underneath the zone of influence shall be backfilled with 4" of crushed stone or sand bedding under the pipe. Each pipe section shall be anchored into unexcavated earth on both ends with deadman anchor system. The remainder of the trench in the zone of influence shall be backfilled with cementitious flowable fill. The zone of influence is the area within a 45 degree angle projecting down from the top edge of the footing on all sides of the footing.
- 1.28 Piping for all drainage systems shall be installed to permit flow, trapping, and venting in accord with current codes and best practice.
- 1.29 Install all gas piping per NFPA54. Union or valves shall not be installed in an air plenum. Piping below slab must be sleeved and vented. Piping installed in contained non-vented areas shall not have mechanical joints.
- 1.30 The entire domestic hot, cold and recirculating hot water piping system shall be sterilized in strict accord with requirements of the Department of Health Codes, Rules and Regulations for the State in which the work is being accomplished.
- 1.31 The entire sanitary waste and vent piping system within the building shall be air-tight. If any sewer gases are present within the building, it shall be the Contractor's responsibility to locate and correct any leaks and retest as required. Any sewer odor issues that occur during the Warranty Period shall be corrected by the Contractor.
- 1.32 When connecting to an existing hydronic water system (chilled, hot, etc.) the Contractor shall include cost to drain the existing piping system and refill with water/closed loop chemicals to match existing fluid. If the building is occupied, and the drain down will affect services to these occupied areas, then the systems shall be drained and refilled over a weekend at a time acceptable to the Owner. Refer to Specification Section PIPE FILLING, CLEANING, FLUSHING, PURGING AND CHEMICAL TREATMENT.

PART 2 – UNIONS, FLANGES AND WELDED TEES:

- 2.1 Screwed unions, soldered unions or bolted flanges shall be provided as required to permit removal of equipment, valves and piping accessories from the piping system. Keep adequate clearances for coil removal, rodding, tube replacement, motor lubrication, filter replacement, etc. Flanged joints shall be assembled with appropriate flanges, gaskets and bolting. The clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system.
- 2.2 Dielectric insulating couplings or through ways shall be used wherever the adjoining materials being connected are of dissimilar metals such as connections between copper and steel pipe.
- 2.3 Tee connections for welded pipe shall be assembled with welding fittings. Where the size of the side outlet is such that a different connection technique than on the run is required, a weldolet, sockolet, or threadolet type fitting may be used for the branch in place of reducing tees only where the branch is 2/3 the run size or smaller. Weld-o-let and thread-o-let branch connections are acceptable.

PART 3 – SPECIFICATIONS STANDARDS:

- 3.1 All piping and material shall be new, comply with the "Buy American Act" and shall conform to the following minimum applicable standards:
- Steel pipe; Schedule 40; ASTM A-53.
 - Copper tube; Type K, L, M; ASTM B88-62; Type DWV ASTM B306-62.
 - Cast iron soil pipe; ASA A-40.1 and CS 188-59.
 - Cast iron drainage fittings; ASA B16.12.

- Cast iron screwed fittings; ASA B16.4.
- Welding fittings; ASA B16.9.
- Cast brass and wrought copper fittings; ASA B16.18.
- Cast brass drainage fittings; ASA B16.23.
- PVC pipe; Schedule 40; ASTM D-1785.

PART 4 – PIPE TESTING AND CLEANING:

- 4.1 Piping shall be tested before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory.
- 4.2 Water piping systems shall be subjected to a hydrostatic test of 150 psi. The system shall be proven tight after a twenty-four (24) hour test.
- 4.3 The house drain line, interior storm sewers, interior rain water conductors, and all soil, waste and vent piping shall be subjected to a hydrostatic test of not less than a 10-foot head or an air test of not less than 5 psi and shall hold for 15 minutes.
- 4.4 After fixtures have been installed, the entire plumbing system, exclusive of the house sewer, shall be subjected to an air pressure test equivalent to one inch water column and proven tight. The Contractor responsible shall furnish and install all of the test tees required, including those for isolating any portion of the system for tests.
- 4.5 The Contractor shall perform all additional tests that may be required by the Department of Health or other governing agency.
- 4.6 Any leaks or imperfections found shall be corrected and a new test run until satisfactory results are obtained. The cost of repair or restoration of surfaces damaged by leaks in any system shall be borne by the Contractor.
- 4.7 Contractor shall notify TAB Agency in writing that the domestic water system has been flushed, cleaned and ready for sterilization or sanitizing. No chemicals are to be added to this system until all balancing has been completed for risk of contamination. The TAB firm is to properly notify all parties in writing when they have completed this portion of testing. If not properly coordinated, then the system will require additional sterilization and sanitizing at the Contractor's expense. Refer to TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS Specification Section.
- 4.8 The natural gas service shall be tested in accordance with requirements and/or recommendations of the local gas company.
- 4.9 Natural gas piping downstream of the meter assembly shall be tested per the local gas company requirements or the following (whichever is stricter):
- Low Pressure (up to 14" wc) – Test to 10 psi for 24 hours.
 - Elevated Pressure (up to 2 psi) – Test to 50 psi for 24 hours.
 - Medium pressure (up to 60 psi) – Test to 100 psi for 24 hours.

PART 5 – PITCH OF PIPING:

- 5.1 All piping systems shall be installed so as to drain to a low point. Certain minimum pitches shall be required for this drainage. For proper flow and/or for proper operation, the following pitches shall be required:

- 5.2 INTERIOR SOIL, WASTE AND VENT PIPING: ¼” per foot in direction of flow where possible but in no case less than 1/8" per foot.
- 5.3 CONDENSATE DRAIN LINES FROM COOLING EQUIPMENT: Not less than ¼” per foot in direction of flow.
- 5.4 ALL OTHER LINES: Provide ample pitch to a low point to allow 100 percent drainage of the system.

PART 6 – HVAC PIPING APPLICATIONS

6.1 HYDRONIC PIPING (HOT OR CHILLED WATER SYSTEMS)

- 6.1.1 2” and Smaller: Schedule 40 black steel pipe with screwed fittings or Type “L” hard copper tubing with wrought copper fittings and 95/5 solder.
- 6.1.2 2½” and Larger: Schedule 40 black steel pipe with 125# welded or flanged joints. Weldolets may be used for branch line connections to pipe mains. Type “L” hard copper piping with wrought copper fittings and 95/5 solder may be installed.
- 6.1.3 Schedule 40 Victaulic 107/W07 or approved mechanical grooved pipe couplings and fittings with a minimum 125# rating. Install gaskets as recommended by the manufacturer. Piping system shall be rated for minimum of 250 degrees F water temperature. Mechanical grooved piping may not be used if system water temperature exceeds 250°F. All grooved components must be of one manufacturer.

6.2 CONDENSER WATER PIPING:

- 6.2.1 All Piping except as noted (Refer to the piping schematic on Drawing M5.2 for limits of steel piping): Schedule 40 black steel pipe with 125# welded or flanged joints. Weldolets may be used for branch line connections to pipe mains. Type "L" hard copper piping with wrought copper fittings and 95/5 solder may be installed.
- 6.2.2 All Piping from the Cooling Tower Outlet to the Storage Tanks and all Condenser Piping from the 90° Elbow Turning Out to the Cooling Tower Inlet: Schedule 80 PVC with galvanized grooved couplings and galvanized fittings. Grooved couplings shall be flexible couplings for steel pipe.
- 6.3 AIR VENT DISCHARGE LINES: Type "L" soft copper; wrought copper fittings, 95/5 solder. Pipe to a suitable drainage location.

6.4 CONDENSATE DRAIN LINES

- 6.4.1 Schedule 40 PVC with solvent welded fittings. Strap exposed piping directly to wall with a 2-hole strap and paint piping to match the wall. Insulate piping located in a return plenum. See drawings for locations.

PART 7 – PLUMBING PIPING APPLICATIONS:

7.1 SOIL, WASTE AND VENT PIPING (BELOW SLAB):

- 7.1.1 Service weight cast iron hub and spigot piping with compression gasket joints.
- 7.1.2 Piping below slab shall be a minimum of 2” in size.

7.2 SOIL, WASTE AND VENT PIPING (ABOVE SLAB):

- 7.2.1 Service weight hubless cast iron pipe with manufacturer's approved bands.
- 7.3 DOMESTIC COLD, HOT AND RECIRCULATING HOT WATER PIPING (ABOVE SLAB):
- 7.3.1 Type "L" hard copper tubing with wrought copper fittings with lead free solder equivalent in performance to 95/5. (Maximum lead content of solder and flux is 2%).
- 7.4 NATURAL GAS PIPING – INTERIOR:
- 7.4.1 Schedule 40 black steel pipe with malleable iron threaded fittings for pipe sizes 2" and smaller.
- 7.4.2 Schedule 40 black steel pipe with wrought steel butt welded fittings for pipe sizes 2½" and larger.
- 7.4.3 Where gas pressure is 2 psi or greater, piping shall be schedule 40 black steel pipe with wrought steel butt welded fittings.
- 7.4.4 Paint all exterior piping as specified in Section IDENTIFICATIONS, TAGS, CHARTS, ETC.
- 7.5 WATER HEATER RELIEF LINE: Type "M" copper tubing with sweat fittings and 95/5 solder.

END OF SECTION.

DIVISION 20 – MECHANICALSECTION 201310 – PIPE FILLING, CLEANING, FLUSHING, PURGING AND CHEMICAL TREATMENTPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 Review the Specification Section – REQUIRED SHOP DRAWINGS, ETC., and provide all documentations called for therein.
- 1.3 Through coordination with other Contractors, Vendors and Suppliers associated with this Project, this Contractor shall ensure a complete, 100% functional, tested, inspected and approved systems. Claims for additional cost or change orders will immediately be rejected.
- 1.4 Maintain a water treatment program for the closed loop piping systems. It is the Contractor's responsibility to contact the engineer 2 weeks in advance to any treatments performed on the systems. It is the Engineer's discretion whether or not this process should be monitored after notification.
- 1.5 A pre-installation meeting shall be held with the Owner, Architect, Engineer, General Contractor, Mechanical Contractor, Pipe Fitter Foreman, and Chemical Treatment Contractor to discuss goals and expectations for cleaning, flushing, purging and chemical treatment.
- 1.6 Chemicals, equipment, testing services, and chemical application shall be supplied by a single water treatment company for undivided responsibility. The water treatment company shall be a recognized specialist, active in the field of commercial/industrial water treatment for at least 5 years. The water treatment company shall have regional water analysis laboratories, service department, and full time representatives located within the area of the job site or facility.
- 1.7 Prior to any construction, the Contractor shall sample the existing closed loop chemicals and provide chemical treatment water quality analysis. Provide levels for all items noted in paragraph "Water Quality Minimum Performance Requirements for Closed Loops". Provide a report to the Engineer.
- 1.8 Be advised the existing loop contains an anti-freeze mixture. Prior to any construction, the Contractor shall sample the existing closed loop and provide anti-freeze mixture data.
- 1.9 Furnish initial supply of the closed loop chemicals for each system. This contractor shall retest the systems after 3, 6, 9 and 12 months upon substantial completion to verify the proper dosage is in each system. Provide all closed loop chemicals and anti-freeze for the first year. The Contractor shall determine the appropriate chemical volumes for each system. Each system's water shall be tested for proper chemical parameters, clarity, and biological activity. If needed, provide chemical addition, including anti-freeze. Provide any laboratory and technical assistance required to achieve a successful program.
- 1.10 As a condition of acceptance and project closeout, a summary of water quality and treatment shall be provided in writing to the Owner and/or Engineer after the water treatment services have been successfully completed. The closeout documentation shall include dates for warranty testing.
- 1.11 Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment. Base HVAC water treatment on quality of water available at Project site, HVAC system

equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

1.12 WATER QUALITY MINIMUM PERFORMANCE REQUIREMENTS FOR CLOSED LOOPS:

- Closed hydronic systems shall maintain a pH value within 9 – 10.5 pH for iron and copper piping loops.
- Total Anaerobic Plate Count - Maintain a maximum value of 100 organisms/ml.
- Nitrate Reducers (Denitrifying Bacteria) - Maintain below a maximum value of 10,000 organisms/ml.
- Sulfate Reducers - Maintain below a maximum value of 200 organisms/ml.
- Iron Bacteria - Maintain below a maximum value of 100 organisms/ml.
- Slime Bacteria - Maintain below a maximum value of 1,000 organisms/ml.

PART 2 – CLEANING AND FLUSHING OF HYDRONIC PIPING:

- 2.1 This project consists of the following Hydronic Piping Loops:
- Hot Water
 - Chilled Water
- 2.2 There are several precautions which must be observed during piping installation. This contractor is advised to read all of the manufacturer's instructions prior to commencing the installation. This cleaning and flushing of the systems must be accomplished.
- 2.3 All water circulating systems for the project shall be thoroughly cleaned before placing in operation to rid the system of dirt, piping compound, mill scale, oil and any and all other material foreign to the water. During construction, extreme care shall be exercised to prevent all dirt and other foreign matter from entering the pipe or other parts of the system. Pipe stored on the project shall have the open ends capped and equipment shall have all openings fully protected. Before erection, each piece of pipe, fitting or valve shall be visually examined and all dirt removed.
- 2.4 After the piping is complete:
- 2.4.1 The Contractor shall first fill the piping loops and all runouts with clear water. The loop water shall be circulated for one hour with make-up water open and boiler drain open to accomplish initial flushing of the system.
- 2.4.2 After initial flushing, all strainers shall be cleaned and the individual terminal devices and coils shall be connected permanently to the supply and return runouts conditions and then add trisodium phosphate in an aqueous solution to the system at the proportion of one pound per fifty gallons of water in the system.
- 2.4.3 After the system is filled with this solution, the loop shall be allowed to circulate for 24 hours.
- 2.4.4 The Chemical Treatment Contractor shall be given notice by the Contractor of scheduling this cleaning and, if the Engineer's representative deems it necessary, the operation shall be repeated.
- 2.4.5 After the system has been completely cleaned as specified herein, it shall be tested by litmus paper or other dependable method and shall be left on the slightly alkaline side.
- 2.4.6 If the system is found to be still on the acid side, the cleaning by use of Trisodium Phosphate shall be repeated.
- 2.4.7 After the cleaning including all strainers and flushing is complete, and approved by CMTA, the Contractor shall provide the proper water treatment for the system.

PART 3 – CLOSED LOOP CHEMICAL TREATMENT:

- 3.1 Provide a 3/4" valved and capped port for injection of the closed loop chemicals into the system.
- 3.2 After the system is complete it shall be thoroughly cleaned before placing in operation to rid the system of dirt, biological contamination, piping compound, loose mill scale, oil, and any and all other material foreign to the water as previously specified.
- 3.3 Before chemical cleaning and sterilization of the entire system, the field and hydronic loop and mains shall be individually flushed and purged until free of dirt, debris, and air.
- 3.4 After chemical cleaning, the entire system shall be sterilized with a biocide added at recommended dosage to effectively kill any present microorganisms. Add glutaraldehyde to achieve 60 – 200 ppm of active ingredient or isothiazoline to achieve 10 – 13 ppm active. Do not flush biocide from system. Corrosion inhibitors shall be installed in closed loop systems containing metal piping, fittings, accessories, etc.
- 3.5 A bacteria analysis shall be performed to ascertain biological cleanliness of system. If bacteria counts are above set parameters then sterilization process shall be repeated until bacteria counts are at or below acceptable levels. Microbiological limits are listed under “Water Quality Minimum Performance Requirements” elsewhere in this Specification Section.
- 3.6 Within 48 hours of the completion of the sterilization and confirmation that bio-levels are within the specified parameters, implement a water treatment program to passivate all metal surfaces.

PART 4 – OPEN LOOP COOLING TOWER WATER TREATMENT SYSTEM:

- 4.1 Electrical work required for system interlock and installation of the chemical treatment system shall be included in the bid and installed per applicable codes. Coordinate with other trades as required for installation of a complete system.
- 4.2 Provide a pre-engineered automatic water treatment system to control the total dissolved solids, prohibit biological built-up and prevent scale and corrosion from forming. The system shall be micro-processor based capable of controlling the entire condenser water system. The system shall consist of any required new equipment.
- 4.3 The chemicals shall be fed from the tanks in which they are shipped. One tank shall contain a biocide. The other shall contain a scale and corrosion inhibitor. Two positive displacement chemical feed pumps. One pump is required to supply a biocide into the loop. One pump is required to supply scale and corrosion inhibitor into the loop.
- 4.4 Provide a conductivity control panel, including controller, probe and water flow switch.
- 4.5 Provide bleed-off valves for the loop. Pipe per detail on the drawings.
- 4.6 Provide new stainless steel injector quills with check valve. The quills shall inject chemicals into the loops per details on the drawings.
- 4.7 Provide electronic water meter and 7-day, 24-hour time clock for pump controls.

4.8 The conductivity control panel shall continually monitor the total dissolved solids level. When the solids exceed the preset level, the bleed-off valve will be opened. When a preset amount of make-up water has been used, the scale and corrosion feed pump shall operate. The biocide feed pump shall operate on a preset schedule controlled by the time clock. The chemical feed pumps shall not be allowed to operate if water flow is not sensed by the water flow switch.

4.9 All wiring shall be installed in EMT conduit.

END OF SECTION.

DIVISION 20 - MECHANICALSECTION 201320 - WELDINGPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 All welding accomplished by any Mechanical Contractor shall comply with provision of the latest revision of applicable codes, whether ASME Boiler and Pressure Vessel Code for pressure piping or such State and Local requirements as may supersede these codes.
- 1.3 Welds shall be of sound metal thoroughly fused to the base metal at all points, free from cracks and reasonably free from oxidation blow holes and non-metallic inclusions. No fins or weld metal shall project within the pipe and should they occur they shall be removed. All pipe beveling shall be done by machine. The surface of all parts to be welded shall be thoroughly cleaned free from paints, oil, rust or scale at the time of welding, except that a light coat of oil may be used to preserve the beveled surfaces from rust.
- 1.4 Pipe and fittings shall be carefully aligned with adjacent parts and this alignment must be preserved in a rigid manner during the process of welding.
- 1.5 Each Contractor shall be responsible for quality of welding done by his organization and shall repair or replace any work not done in accordance with specifications. If required by the Architect/Engineer, the Contractor shall cut out at least five (5) welds during the job for X-raying and testing. These welds shall be selected at random by the Resident Inspector and shall be tested as a part of the Contractor's Contract. Certifications of these tests and X-rays shall be submitted, in triplicate to the Engineer. In case a faulty weld is discovered, the Contractor shall be required to furnish additional tests.

PART 2 – WELDING QUALIFICATIONS:

- 2.1 Pipe welding shall comply with the provisions of the latest revision of the applicable codes, whether ASME Boiler and Pressure Vessel Code, ASA Code for Pressure Piping, or such state or local requirements as may supersede codes mentioned above.
- 2.2 Before any pipe welding is performed, submit to the Owner, a copy of the welding procedure specifications, together with proof of its qualification as outlined and required by the most recent issue of the code having jurisdiction.
- 2.3 Before any welder shall perform any pipe welding, submit to the Owner the Operator's qualification record in conformance with the provisions of the code having jurisdiction, showing that the operator was tested under the proven procedure specifications submitted.
- 2.4 Standard Procedure Specifications and Welders qualified by the National Certified Pipe Welding Bureau shall be considered as conforming to the requirements of these specifications.

PART 3 – MATERIALS:

- 3.1 Welding fittings shall conform to ASA B16.9; of the same materials, thickness, etc., as the pipe being jointed; see ASA B36.10.

END OF SECTION.

DIVISION 20 - MECHANICALSECTION 202100 - VALVESPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 Each Contractor shall provide all valves required to control, maintain and direct flow of all fluid systems indicated or specified. This shall include, but may not be limited to all valves of all types including balancing valves, air vents, drain valves, check valves, special valves for special systems, etc., for all Mechanical Systems.
- 1.3 ACCEPTABLE MANUFACTURERS: Lunkenheimer, Powell, Nibco, Crane, Jenkins, T & S Brass, Walworth, Milwaukee, DeZurik, Consolidated Valve Industries, Inc., Bell & Gossett, Apollo.
- 1.4 The following type valves shall not be acceptable: Zinc, plastic, fiber or non-metallic.
- 1.5 Each type of valve shall be of one manufacturer, i.e., ball valves, one manufacturer, butterfly valves, one manufacturer, check valves, one manufacturer, etc.
- 1.6 All valves shall comply with current Federal, State and Local Codes. All valves shall be new and of first quality. All valves shall be designed and rated for the service to which they are applied. Zinc, plastic, fiber or non-metallic valves shall not be acceptable.
- 1.7 Contractor shall provide colored tape on ceiling tile where valves are located above ceiling. Provide access panels where valves are located above hard ceiling.

PART 3 – DOMESTIC WATER APPLICATIONS:

- 3.1 GATE VALVE (2" AND UNDER): Use ball valves as specified.
- 3.2 GATE VALVE (2" AND UNDER): Gate valve shall have bronze body, union bonnet, non-rising stem solid wedge and handwheel. Gate valve shall be rated for 150 psi working pressure. Gate valve shall be Nibco T-136 for threaded ends and Nibco S-136 for solder ends.
- 3.3 GATE VALVE (2½" AND LARGER): Gate valve shall have bronze body, bonnet and solid wedge. Gate valve shall be rising stem with bolted bonnet and solid wedge. Valve shall have rated for 150 psi working pressure. Gate valve shall be Nibco T-134 for threaded ends or Nibco S-134 for solder ends.
- 3.4 GLOBE VALVES (2" AND UNDER): Globe Valves shall have bronze body, bonnet and disc holder. Globe valve shall have union bonnet, integral seat, teflon or stainless steel renewable disc and be rated for 150 psi working pressure. Globe valve shall be Nibco T-235 for threaded ends or Nibco S-235 for solder ends.
- 3.5 CHECK VALVE (2" AND UNDER): Check valve shall have bronze body, disc and hinge. check valve shall be Y-pattern type, horizontal swing, renewable disc and rated for 150 psi working pressure. Check valve shall be Nibco T-413 for threaded ends or Nibco S-413 for solder ends.
- 3.6 TWO PIECE BALL VALVE (2" AND UNDER): Ball valve shall have bronze body, ball and reinforced, water tight seat. Valve shall be two piece construction. Valve shall be "full-port" type. Valve handle shall

- only require quarter turn to go from full open to full close. The handle shall be removable with vinyl grip. Valve shall be rated for 180 degrees F water temperature and 150 psi working pressure. Ball valve shall be Nibco T-585 for threaded ends and Nibco S-585 for solder ends.
- 3.7 BALL VALVES (2½"-3"): Ball valve shall have bronze body, ball and reinforced, watertight seat. Valve handle shall only require quarter turn to go from full open to full close. The handle shall be removable with vinyl grip. Valve shall be rated for 250 degrees F water temperature and 200 psi working pressure. Ball valve shall be Nibco T-580 for threaded ends and Nibco S-580 for solder ends. Provide extended handles for all ball valves installed in an insulated system.
- 3.8 THREE PIECE BALL VALVE (2" AND UNDER): Ball valve shall have bronze body, ball and reinforced, water tight seat. Valve shall be three piece, swing-out, construction to facilitate inspection and repair. Valve shall be "full-port" type. Valve handle shall only require quarter turn to go from full open to full close. The handle shall be removable with vinyl grip. Valve shall be rated for 180 degrees F water temperature and 150 psi working pressure. Ball valve shall be Nibco T-595 for threaded ends and Nibco S-595 for solder ends.
- 3.9 STRAINERS (2" AND UNDER): Watts 77S Series "Y" type strainer with cast iron body and threaded ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with cleanout plug and be rated for 200 psi working pressure.
- 3.10 STRAINERS (2½" AND LARGER): Watts 77F Series "Y" type strainer with semi-steel body and flanged ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with bolted cleanout and be rated for 200 psi working pressure.
- 3.11 PRESSURE REDUCING VALVES: Watts #U5B water pressure reading valve with bronze body, bolted bonnet, integral stainless steel strainer and outlet water pressure gauge. Internal disc, diaphragm and stainless steel seat shall all be removable. Valve shall be rated for inlet water pressures up to 300 psi. Water pressure reducing valves shall be provided for all equipment where water pressure exceeds the equipment manufacturer's ratings.
- 3.12 VACUUM BREAKERS: Watts #288A atmospheric type vacuum breaker with brass body. Vacuum breaker shall be rated for 210 degrees F and 125 psi working pressure and shall meet ASSE Standard 1001.
- 3.13 DOUBLE CHECK VALVE: Double check valve shall have bronze body construction and be provided with inlet strainer, two (2) gate valves for isolation and three (3) test ports. Assembly shall be rated for 110 degrees F water temperature and 175 psi water pressure. Assembly must meet requirements of AWWA Standard C506. For sizes 2" and less, provide Watts #900 (or equal) with threaded ends. For sizes 2½" and larger, provide Watts #709 (or equal) with flange ends.
- 3.14 REDUCED PRESSURE BACKFLOW PREVENTERS: Reduced pressure backflow preventers shall be provided with inlet strainer, two (2) gate valves/ball valves for isolation, three (3) test ports and air gap fitting. Assembly shall be rated for 110 degrees F water temperature and 175 psi water pressure. RPBP shall be UL listed and meet AWWA C511 standards. Watts #LF909 or equal by Wilkins or Conbraco. All valves 3" and less in size shall bronze body lead-free construction, over 3" in size shall have epoxy coated cast iron bodies. Assemblies 2" and under in size shall have threaded ends, over 2" in size shall have flange ends. Perform backflow preventer test and provide results with closeout documentation. All reduced pressure backflow preventers shall be mounted a maximum of 48" above the finished floor, unless noted otherwise.
- 3.1 BALANCING VALVE: ThermOmegaTech Model "Circuit Solver" or equal balancing valve. Valves to be sized per line size on plan.

PART 4 – HVAC APPLICATIONS:

- 4.1 GATE VALVE (2" AND UNDER): Use ball valves as specified.
- 4.2 OS&Y GATE VALVES: OS&Y gate valve shall have cast iron body with cast iron bolted bonnet, bronze rising stem, solid cast iron wedge and handwheel. From viewing stem, valve position shall be capable of being determined. Valve shall be rated for 200 psi service. OS&Y gate valve shall be Nibco F-617-0 with flanged ends.
- 4.3 GLOBE VALVE (2" AND UNDER): Globe valve shall have bronze body, bonnet and disc holder. Globe valve shall have union bonnet, integral seat, teflon or stainless steel renewable disc and be rated for 200 psi working pressure. Globe valve shall be Nibco T-235 for threaded ends or Nibco S-235 for solder ends.
- 4.4 GLOBE VALVES (2½" AND OVER): Globe valve shall have cast iron body, bolted bonnet, bronze disc, renewable seat and have outside screw and yoke. Handwheel to be cast iron. Globe valve to be rated for 200 psi working pressure. Globe valve shall be Nibco F-718 for flanged ends of Nibco T-718 for threaded ends. Threaded ends valve allowed for sizes 3" and less only.
- 4.5 CHECK VALVES (2" AND LESS): Check valve shall have bronze body, disc and hinge. Check valve shall be Y-pattern type horizontal swing, renewable disc and rated for 200 psi working pressure. Check valve shall be Nibco T-413 for threaded ends or Nibco S-413 for solder ends.
- 4.6 CHECK VALVES (2½" AND LARGER): Check valve shall have cast iron body and cast iron bolted bonnet the disc and seat ring shall be bronze. Check valve shall be horizontal swing with renewable seat and disc. Valve shall be rated for 200 psi working pressure. Check valve shall be Nibco F-918 for flanged ends and Nibco T-918 for threaded ends. Threaded ends valve allowed for sizes 3" and less only. Victaulic 716/W716 are acceptable with grooved piping systems.
- 4.7 TWO PIECE BALL VALVES (2" AND UNDER): Ball valve shall have bronze body, ball and reinforced, watertight seat. Valve shall be two piece construction. Valve shall be "full port" type. Valve handle shall only require quarter turn to go from full open to full close. The handle shall be removable with vinyl grip. Valve shall be rated for 250 degrees F water temperature and 200 psi working pressure. Ball valve shall be Nibco T-585 for threaded ends and Nibco S-585 for solder ends. Provide extended handles for all ball valves installed in insulated piping systems.
- 4.8 BALL VALVES (2½"-3"): Ball valve shall have bronze body, ball and reinforced, watertight seat. Valve handle shall only require quarter turn to go from full open to full close. The handle shall be removable with vinyl grip. Valve shall be rated for 250 degrees F water temperature and 200 psi working pressure. Ball valve shall be Nibco T-580 for threaded ends and Nibco S-580 for solder ends. Provide extended handles for all ball valves installed in chilled water piping systems.
- 4.9 BUTTERFLY VALVE (4" AND LARGER): Butterfly valve shall have cast iron body with bronze disc. Valve to have extended neck to allow for insulation and be "lug" type configuration. Interior liner shall be made of EPDM. Lever handle shall be lock type with 10 position settings. Valve to be rated for 200 psi working and have positive shut-off equal to Hammond 6411 Series. Provide a gear operator for all valves 8" and larger. Victaulic Vic-300 and Tri Service assembly is acceptable with grooved piping system.
- 4.10 STRAINERS (2" AND UNDER): Watts 77S Series "Y" type strainer with cast iron body and threaded ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with cleanout plug and be rated for 200 psi working pressure.
- 4.11 STRAINERS (2½" AND LARGER): Watts 77F Series "Y" type strainer with semi-steel body and flanged ends. Screen shall be 20 mesh stainless steel. Strainer shall be provided with bolted cleanout and be rated for 200 psi working pressure.

- 4.12 BALANCING VALVE (4" AND LESS): Balancing valve shall have bronze or cast iron body. Valves to have differential pressure readout ports across valve seat area with integral check valves. Valve shall be equipped with memory stop. Valves to have threaded ends for sizes 3" and less, flanged ends for larger sizes. Valve to be provided with performed molded insulation casing. Design working pressure and temperature to be 200 psi at 250 degrees F balancing valve shall be similar to Bell & Gossett Model CB or Nexus UltraMB Model MBF. Provide with balancing valves, one (1) water gpm readout kit to be turned over to Owner which shall include a differential pressure meter with full scale overrange protection, hoses, readout probes, filters, carry and calculator.
- 4.13 FLEXIBLE CONNECTION: Pumpsaver SMP or equal braided stainless steel pump connector(s). Construction to be of annular corrugated stainless steel close-pitch hose with stainless steel overbraid. The corrugated metal hose, braid(s), and a stainless steel ring-ferrule/band (material gauge not less than .048") must be integrally seal-welded using a 100% circumferential, full-penetration TIG weld. End fittings shall be flat-face plate steel flanges with 150# ANSI drilling and outside diameter. Fittings must be attached using a 100% circumferential TIG weld. Braided stainless steel pump connector(s) must be suitable for operating temperatures up to 850 degrees F. The rated working pressure of the braided metal hose must have a minimum 4:1 safety factor. Each braided stainless steel pump connector shall be individually leak tested by the manufacturer using air-under-water or hydrostatic pressure. Flanged pump connectors shall be prepared for shipment using cut-to-length spacers, securely positioned between the flanges to prevent axial compression damage and maintain the manufactured length. Spacers must be removed prior to system start up.
- 4.14 AUTOMATIC AIR VENT: Bell & Gossett Model 107A high capacity float actuated automatic air vent with cast iron body and bonnet. Vent to be rated for 150 psi working pressure and 240 degrees F working temperature. Pipe discharge to nearest floor drain unless noted otherwise.
- 4.15 MANUAL AIR VENT: Bell & Gossett Model 78 manual air vent with cast brass body and built-in check valve. Vent to be rated for 150 psi working pressure and 240 degrees F working temperature. Install with 12" length of 1/4" soft copper discharge piping unless noted otherwise.

END OF SECTION.

DIVISION 20 – MECHANICAL

SECTION 202200 – INSULATION - MECHANICAL

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 Work under this section shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for all mechanical systems specified herein and/or as indicated.
- 1.3 Application of insulation materials shall be performed in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer for specific use.
- 1.4 Insulation thicknesses shall comply with the latest version of ASHRAE 90.1 and IECC at a minimum.
- 1.5 All insulation materials shall be installed per the latest edition of the National Commercial and Industrial Insulation Standards.
- 1.6 Insulation shall be installed by a company regularly engaged in the application of insulation and any work deemed unacceptable by the Engineer shall be removed and properly installed at the expense of the Contractor.
- 1.7 The Contractor shall photograph any installations prior to concealment. This includes duct risers in chases and at rooftop equipment.

PART 2 – ACCEPTABLE MANUFACTURERS:

- 2.1 Johns Manville, Knauf, Owens-Corning.

PART 3 – FIRE RATINGS AND STANDARDS:

- 3.1 Insulations, jackets, facings, adhesives, mastics, tapes, fitting materials, etc. shall have composite fire and smoke hazard ratings as tested by ASTM E-84, NFPA 255 and UL 723 procedures not exceeding Flame Spread 25, Smoke Developed 50 and Fuel Contributed 50.
- 3.2 All products and their packaging shall bear a label indicating above requirements are not exceeded.
- 3.3 Fiber glass duct wrap shall meet the requirements of Scientific Certification Systems Certification or Greenguard Validation of Formaldehyde Free.
- 3.4 Fiber glass mechanical board shall meet the requirement of the Greenguard Standards for Low-Emitting Products.
- 3.5 Fiber glass pipe insulation shall meet the requirement of the Greenguard Gold level standard.

PART 4 – GENERAL APPLICATION REQUIREMENTS:

- 4.1 “Concealed”, where used herein, shall mean hidden from sight as in trenches, chases, furred spaces, pipe shafts, or above hung finished ceilings. “Exposed” shall mean that piping or equipment is not “concealed” as defined above. Piping and equipment in service tunnels, mechanical equipment rooms, storage areas, or unfinished rooms is to be considered “exposed”.
- 4.2 Insulation shall be applied on clean, dry surfaces in a neat and workmanlike manner reflecting the best current practices in the trade. Insulation shall not be applied to piping, ductwork or equipment until tested, inspected and released for insulation.
- 4.3 Where more than one thickness of insulation is required, joints (both longitudinal and transverse) shall be staggered.
- 4.4 All insulation shall be continuous through walls, ceiling openings and sleeves. However, insulation shall be broken through fire walls. All covered pipe and ductwork is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. If necessary, extra fittings and pipe are to be used. No noticeable deformation of insulation or discontinuity of vapor seal, where required, will be accepted. Coordinate work with plumbers, pipe fitters, etc. to assure hanger locations agree with location of insulation inserts.
- 4.5 Existing and/or new insulation removed and/or damaged during course of construction shall be repaired or replaced by the Contractor at their expense.
- 4.6 Vapor barrier jackets shall be applied with a continuous unbroken vapor seal. Do not use staples through the jacket. NO EXCEPTIONS!
- 4.7 All insulation shall be installed with joints butted firmly together.
- 4.8 The Contractor shall ensure that all insulation (piping, ductwork, equipment, etc.) is completely continuous along all conduits, equipment, connection routes, etc. carrying cold fluids (air, water, other) and that condensation can, in no way, collect in or on the insulation, equipment, conduits, etc. Any such occurrence of condensation collection and/or damage therefrom shall be repaired solely at the expense of the Contractor.
- 4.9 Unless otherwise specified or allowed, closed cell type insulation shall not be acceptable.
- 4.10 Piping and ductwork supports, including hangers, straps, uni-strut and all-thread rods, for insulated piping and ductwork shall be insulated and vapor sealed a minimum of 18” minimum beyond the piping and ductwork to prevent condensing. Coordinate with Sheetmetal Contractor.

PART 5 – PIPING SYSTEMS:

- 5.1 Seal insulation and jacket at all points where insulation terminates at unions, flanges, valves and equipment. This applies to hot water lines only as cold water lines require continuous insulation and vapor barrier.
- 5.2 Pipe insulation shall extend around valve bodies to above drain pans in hydronic equipment over pumps, etc. to ensure no condensation drip or collection.
- 5.3 Valves, flanges and unions shall only be insulated when installed on cold fluid piping whose surface temperature will be at or below the dew point temperature of the ambient air.

5.4 Insulation shall not extend through fire and smoke walls. Pack sleeve at fire and smoke wall with approved fire retardant packing similar to mineral wool and seal with approved sealant.

5.5 Metal insulation shields and inserts are required at all pipe hangers where the piping is insulated. Metal shields shall be constructed of galvanized steel, formed to a 180 degree arc. Insulation shields shall be the following size:

| Pipe Size | Shield Gauge | Shield Length |
|-------------|--------------|---------------|
| 2" and less | 20 | 12" |
| 2 1/2"- 4" | 18 | 12" |
| 5"- 10" | 16 | 18" |
| Over 10" | 14 | 24" |

5.6 Insulated pipes 2" in diameter and larger shall be additionally supported with wood inserts of sufficient compressive strength to carry the weight of the pipe and fluid. Inserts shall extend beyond extend beyond the hanger and shall be at least 6" in length.

5.7 Provide premolded PVC insulated fitting covers on all pipe fittings, flanges, valves and pipe terminations. Fittings shall be insulated by applying the proper factory precut insulation insert to the pipe fitting. The ends of the insulation insert shall be tucked snugly into the throat of the fitting and the edges adjacent to the pipe insulation tufted and tucked in, fully insulating the pipe fitting. The proper thickness of insulation must be applied to keep the jacket temperature less than 150°F. An approved vapor retarder mastic compatible with the PVC shall be applied around the edges of the adjoining pipe insulation and on the fitting cover throat overlap seam. The PVC fitting cover shall then be applied and secured with pressure sensitive tape along the circumferential edges. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side. On fittings where the operating temperature is below 50°F, two or more layers of the insulation inserts shall be applied with the first layer being secured with a few wrappings of fiber glass yarn to eliminate voids. One additional insert shall be used for each additional 1" of pipe insulation above 1-1/2". All joints shall be fully sealed.

5.8 PIPE INSULATION MATERIAL: Insulation shall be Knauf "Earthwool 1000° Pipe Insulation ASJ+/SSL+" or approved equivalent fiberglass pipe insulation with an all service jacket. The insulation shall be a heavy density, pipe insulation with a K factor not exceeding 0.27 Btu per inch/h.ft² °F at 75°F mean temperature. The insulation shall be wrapped with a vapor barrier jacket. The jacket shall have an inside foil surface with self sealing lap and a water vapor permeability of 0.02 perm/inch. All circumferential joints shall be vapor sealed with butt strips. All insulation shall be installed in strict accordance with the manufacturer's recommendations. The following pipes shall be insulated with the minimum thickness of insulation as noted.

- 5.8.1 Domestic Cold Water: 1" thick insulation
- 5.8.2 HVAC Fill Lines: 1" thick insulation
- 5.8.3 Exterior HVAC Fill Lines: 1" thick insulation with heat trace jacketing
- 5.8.4 Domestic Hot Water & Return Lines:
 - Piping 1-1/4" and less: 1" thick insulation
 - Piping 1-1/2" and greater: 1-1/2" thick insulation
- 5.8.5 Hydronic Chilled Water:
 - All interior piping: 1" thick insulation
 - All exterior piping: 2" thick with heat trace and jacketing
- 5.8.6 Hydronic Hot Water:
 - Piping 1-1/4" and less 1-1/2" thick insulation

- Piping 2" and greater 2" thick insulation
 - All exterior piping: 3" thick with heat trace and jacketing
- 5.8.7 Condensate Drain Lines: 1/2" thick.
- 5.8.8 Floor Drain Sanitary Pipes: All floor drains that have condensate spilled to the drain, and the sanitary pipe is not below slab, shall have its respective sanitary pipe insulated with 1" thickness. Insulate the pipe until it connects to a 4" main, but a minimum of 20 feet in the direction of flow.
- 5.9 EXPOSED, INTERIOR (INTERIOR FINISHED ROOMS, STORAGE ROOMS, ETC.) PIPING JACKETS: All insulated piping installed in the above areas shall have a 6 oz. canvas jacket with fire retardant lagging apply to the insulation specified for the piping.
- 5.10 EXTERNALLY INSULATED DUCT – OUTDOORS: 2" rigid fiberglass industrial board with foil scrim kraft vapor barrier facing, 6.0 PCF density, $K=0.23 \text{ Btu in/hr.ft}^2 \text{ }^\circ\text{F @ } 75^\circ\text{F}$. Owens/Corning or approved equivalent industrial installation type 705. Weather proofing shall be Polyguard Alumaguard, all weather, proofing jacket with brite white finish, or approved equivalent. Use semi-rigid Type 703/704 insulation for round ducts. The installed R-value shall be a minimum of 8.0.

PART 6 – DUCTWORK SYSTEMS:

- 6.1 Duct sizes indicated are the net free area inside clear dimensions; where ducts are internally lined, overall dimensions shall be increased accordingly.
- 6.2 Duct insulation shall extend completely to all registers, grilles, diffusers, and louver outlets, etc., to ensure no condensation drip or collection.
- 6.3 EXTERNAL INSULATION FOR SUPPLY AIR DUCTWORK: Knauf "Friendly Feel" faced, Duct Wrap, 0.75 PCF density, 2.2" thick or approved equivalent. Wrap shall be factory laminated to a reinforced foil kraft vapor barrier facing (FRK) with a 2" stapling flange at one edge. The installed R value shall be a minimum of 6.0. Flame spread 25, smoke developed 50, vapor barrier performance 0.02 perms per inch.
- Pre-conditioned outside air supply ductwork downstream of OA unit (under positive pressure) and exhaust air ductwork upstream of OA unit (under negative pressure) does not require insulation. All other duct including louver plenums requires installation per the above.
- 6.4 EXPOSED EXTERNAL INSULATION SUPPLY, RETURN AND OUTSIDE AIR DUCTWORK IN THE MECHANICAL ROOMS AND PENTHOUSES: Knauf "Insulation Board" or approved equivalent industrial insulation. Use 1½" rigid fiberglass industrial board with foil scrim kraft vapor barrier facing, 6.0 PCF density, $K=0.22 \text{ Btu in/hr.ft}^2 \text{ }^\circ\text{F @ } 75^\circ\text{F}$. Use 1/2" thick, 1.6 PCF insulation board for round ducts. The installed R-value shall be a minimum of 6.0. Flame spread 25, smoke developed 50, vapor barrier performance 0.02 perms per inch. Provide 6oz. canvas jacket with fire retardant lagging and provide a metal corner bead at all duct corners (on the exterior of the insulation) for protection. The corner bead shall be taped in place with foil scrim tape.
- 6.5 EXTERNALLY INSULATED DUCT – OUTDOORS: 2" rigid fiberglass industrial board with foil scrim kraft vapor barrier facing, 6.0 PCF density, $K=0.23 \text{ Btu in/hr.ft}^2 \text{ }^\circ\text{F @ } 75^\circ\text{F}$. Owens/Corning or approved equivalent industrial installation type 705. Weather proofing shall be Polyguard Alumaguard, all weather, proofing jacket with brite white finish, or approved equivalent. Use semi-rigid Type 703/704 insulation for round ducts. The installed R-value shall be a minimum of 8.0.

END OF SECTION.

DIVISION 20 – MECHANICALSECTION 202300 – THERMOMETERS, PRESSURE GAUGES AND OTHER MONITORING INSTRUMENTSPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall include all thermometers, pressure gauges and/or compound gauges at the locations indicated. All pressure gauges and/or compound gauges shall be provided with ¼ turn ball valves to allow the gauge to be removed and replaced without shutting down system.

PART 2 – THERMOMETERS AND PRESSURE GAUGES:

- 2.1 Gauges and thermometers shall be Miljoco, Marsh, Trerice, or Weksler.
- 2.2 All thermometers and pressure gauges shall be readable from a standing position on the floor. Mount thermometers in approved wells. Use sensing elements of appropriate length for pipe size. Do not make direct contact of base with fluid in pipe. Pressure gauges and thermometers subject to vibration shall be mounted remotely away from vibrating pipe surface, etc. with flexible tubing.
- 2.3 Digital thermometers shall be solar powered industrial thermometer. The range shall be -50°F/300°F with an accuracy of 1% or 1°, whichever is greater. The display shall be a 3/8" LCD digit. Use where specifically indicated on the drawings.
- 2.4 Water thermometers shall be blue-reading spirit liquid-in-glass type with 9" scale, powder coated cast aluminum case and stem socket of length as required by system. Accuracy to be plus or minus 1 scale division. Lens to be plastic. Hot water thermometer shall have a 30°F to 240°F range and chilled water and geothermal water thermometer shall have a 0°F to 120°F range.
- 2.5 Pressure gauges shall be Bourdon Type, circular, 4-1/2" face, black letters on white face graduated in 2 PSI or less and shall be manufactured for service intended. Provide with pig tail connectors and gauge cocks. Accuracy to be plus or minus 1%. Water pressure and low pressure steam gauges shall have 0 to 100 PSI range and medium/high pressure steam gauges shall have 0 to 200 PSI range.
- 2.6 Provide direct mount Bimetal dial thermometers in HVAC ductwork. Thermometer shall be 3" diameter, with polycarbonate plastic lens and stainless steel case. Air temperature range shall be 25°F to 125°F.

PART 3 – PRESSURE/TEMPERATURE PORT (PETE'S PLUG – P/T PLUG):

- 3.1 Provide 1/4" NPT fitting to receive either a temperature or pressure probe, 1/8" OD. Fitting shall be solid brass with two valve cores. Valve core material to be neoprene for temperatures up to 200°F and Nordel for temperatures up to 275°F. Pete's Plugs to have 3" length when installed on insulated pipes and 1-1/2" length for uninsulated pipes. Pete's Plug to be fitted with a cap and gasket, and shall be rated at 1000 PSIG at 140°F.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 202400 - IDENTIFICATIONS, TAGS, CHARTS, ETC.

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

PART 2 – TAGS AND CHARTS:

- 2.1 Provide and install on each valve 1" in size or greater for all mechanical systems a 1.5" diameter circular bronze or baked phenolic tag fitted to each valve so that it cannot be removed. Each tag shall be embossed consecutively with sequential number identifiers. Number identifiers shall be determined by the Contractor sequentially.
- 2.2 Provide typewritten valve charts indicating each valve identifier, the valves service, normal position and its location. Also furnish one electronic copy on CD in "*.xls" format. One (1) copy of this chart shall be mounted in suitable frame(s) with clear plastic covers in a conspicuous location in each of the major mechanical rooms. Repeat only main valves which are to be operated in conjunction with operations of more than single mechanical room.
- 2.3 All emergency shutoff valves shall be identified with a permanent engraved tag hung from the valve with 1-inch high lettering. Emergency shutoff valves shall be identified as any valve whose closure could create an emergency condition in the facility (i.e. natural gas, water, domestic hot water, main HVAC valves, etc.).
- 2.4 Label all control panels and disconnect switches with service and equipment served.

PART 3 – PIPING AND DUCTWORK IDENTIFICATION:

- 3.1 All piping and ductwork installed shall be identified according to the charts hereinafter specified. Provide stenciled markers and arrows indicating direction of flow on all piping and ductwork installed under this contract. Markers and arrows shall be painted on the piping and ductwork using machine cut stencils. All letters shall be sprayed using fast drying lacquer paint. All markers and arrows shall be properly oriented so that descriptive name may be easily read from the floor. Piping and ductwork shall be identified on twelve (12) foot centers. All piping and ductwork shall be minimally identified once above all room ceilings and where it passes thru walls or floors. At the Contractor's option, Setmark or equivalent manufactured marking system may be substituted for field marking.

- 3.2 The following table describes the size of the color field and size of the identification letters which shall be used for pipes of different outside pipe diameters.

| <u>Outside Diameter</u> | <u>Label Length</u> | <u>Letter Size</u> |
|-------------------------|---------------------|--------------------|
| 3/4" – 1 1/4" | 8" | 1/2" |
| 1 1/2" – 2" | 8" | 3/4" |
| 2 1/2" – 6" | 12" | 1 1/4" |

- 3.3 The following chart describes the pipe service and label identification which shall be used for various pipes.

| <u>PIPE</u> | <u>ABBREVIATION</u> |
|----------------------|---------------------|
| Chilled Water Supply | C.W.S. |

| | |
|------------------------|------------|
| Chilled Water Return | C.W.R. |
| Hot Water Supply | H.W.S. |
| Hot Water Return | H.W.R. |
| Condenser Supply | C.S. |
| Condenser Return | C.R. |
| Domestic Cold Water | D.C.W. |
| Domestic Hot Water | D.H.W. |
| Recirculated Hot Water | R.H.W. |
| Pool Hot Water Supply | P.H.S. |
| Pool Hot Water Return | P.H.R. |
| Soft Water | SOFT WATER |
| Natural Gas | NAT.GAS. |
| Sanitary Vent Piping | VENT |

PART 4 – NATURAL GAS PIPING IDENTIFICATION:

- 4.1 All natural gas piping within mechanical rooms shall be painted safety orange. Natural gas valves shall be painted red. Piping shall be prepped as required and piping shall be painted with at least two coats of paint or more if required to properly cover the piping. Piping in the kitchen shall be painted black. Exterior gas piping shall be painted to match the building with color as directed by the Architect/Owner.
- 4.2 In addition, natural gas piping and meter loop piping shall be painted color as selected by Architect. Do not paint over gauges, name plates or vent/regulator openings.

PART 5 – EQUIPMENT IDENTIFICATION:

- 5.1 Unless otherwise specified, all equipment shall be identified. The titles shall be short and concise and abbreviations may be used as long as the meaning is clear. In finished rooms and mechanical rooms, equipment shall be identified neatly and conspicuously with engraved black lamacoid plates (or equivalent) with 1” high white letters on the front of each piece of equipment.
- 5.2 All mechanical equipment and associated starters/disconnects shall have the electrical panel number and circuit number identified on a lamacoid plate. Coordinate with the Electrical Contractor.

PART 6 – DUCTWORK IDENTIFICATION:

- 6.1 All ductwork shall be identified as to the service of the duct and direction of flow. Include equipment designator on SA & RA ductwork. The letters shall be at least two inches high and the flow arrow shall be at least six inches long. The letters and flow arrow shall be made by precut stencils and black oil base paint with aerosol can. Concealed ducts also need to be identified.

| | | |
|------------|------------------------|----------------------------|
| 6.2 | <u>DUCTWORK</u> | <u>ABBREVIATION</u> |
| | Supply Air Ductwork | SA + Equipment Identifier |
| | Return Air Ductwork | RA + Equipment Identifier |
| | Exhaust Air Ductwork | EA + Equipment Identifier |
| | Outside Air Ductwork | OA + Equipment Identifier |

PART 6 – ACCESS THROUGH LAY-IN CEILINGS:

- 6.1 Mark each lay-in ceiling panel which is nearest access to equipment, valves, dampers, filters, duct heaters, etc., with colored tape labels located on the ceiling grid.

END OF SECTION.

DIVISION 20 - MECHANICAL

SECTION 202500 - HANGERS, CLAMPS, ATTACHMENTS, ETC.

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 Each Contractor's attention is also directed to Specification Section PIPE, PIPE FITTINGS AND SUPPORT.
- 1.3 This section includes, but is not limited to, furnishing and installing supports, anchors, and accessories for piping, ductwork, equipment, etc. Furnishing and installing shall be by each trade for the completion of their work as directed in this Section.

PART 2 – MATERIALS AND EQUIPMENT:

2.1 HANGERS, CLAMPS, ATTACHMENTS SCHEDULE:

- ACCEPTABLE MANUFACTURERS: Grinnell, Elcen, Fee & Mason.
- All hangers, clamps and attachments shall be manufactured products.
- Pipe Rings (2” pipe and smaller) – adjustable swivel split ring or split pipe ring.
- Pipe Clevis (2.5” pipe and larger) – adjustable wrought clevis type.
- Pipe Clevis (All pipe sizes) – steel clevis for insulated pipe.
- Riser Clamps (All pipe sizes) – extension pipe or riser clamp.
- Beam Clamps (All pipe sizes) – malleable beam clamp with extension piece.
- Brackets (All pipe sizes) – medium weight steel brackets.
- Concrete Inserts (All pipe sizes) – wrought or wedge type inserts.
- Concrete Fasteners (All pipe sizes) – self-drilling concrete inserts.
- Rod Attachments (All pipe sizes) – extension piece, rod coupling, forged steel turnbuckle
- U-bolts (All pipe sizes) – standard u-bolt.
- Welded Pipe Saddles (All pipe sizes) – pipe covering protection saddle sized for thickness of insulation.
- Pipe Roll (All pipe sizes) – adjustable swivel pipe roll.
- Protection Saddle (All pipe sizes) – 180 degree coverage, sheet metal pipe protection saddle.
- Hanger Rods (All pipe sizes) – Steel, diameter of hanger threading.
- Concrete Channel Inserts (All pipe sizes) – continuous heavy duty slot inserts unistrut.
- Adjustable Spot Inserts (All pipe sizes) – continuous heavy duty spot insert unistrut.
- Miscellaneous steel such as steel angles, rods, bars, channels, etc used in framing for supports, fabricated brackets, anchors, etc. shall conform to ASTM-A-7.

2.2 HANGER RODS

2.2.1 Hanger rods or single rod hangers shall conform to the following:

| PIPE SIZE | HANGER ROD DIAMETER STEEL PIPE | HANGER ROD DIAMETER COPPER, PLASTIC, HDPE |
|-----------------------|-----------------------------------|--|
| 2” and smaller | 3/8” | 3/8” |
| 2-1/2” through 3-5/8” | 1/2” | 1/2” |
| 4” and 5” | 5/8” | 1/2” |

| | | |
|----------------|------|------|
| 6" | 3/4" | 5/8" |
| 8" through 12" | 7/8" | 3/4" |
| 14" | 1' | 7/8" |

- 2.3 Rods for double rod hangers may be reduced on size. Minimum rod diameter is 3/8 inches.
- 2.4 Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

PART 3 – INSTALLATION:

- 3.1 Supporting and hanging shall be done so that excessive load will not be placed on any one hanger so as to allow for proper pitch and expansion of piping.
- 3.2 Hangers and supports shall be placed as near as possible to joints, turns and branches.
- 3.3 For concrete construction, utilize adjustable concrete inserts for fasteners. Expansion anchors and power driven devices may be used when approved in writing by the Architect/Engineer.
- 3.4 Utilize beam clamps for fastening to steel joists and beams. Expansion anchors in masonry construction. Do not support piping or ductwork from bridging or metal decking.
- 3.5 When piping is routed in joists, piping shall be top mounted on trapeze type hangers with each pipe individually clamped to trapeze hanger. Do not support piping or ductwork from bridging angles.
- 3.6 Trapeze hangers are not allowed, unless specifically approved by the Engineer.
- 3.7 Install all miscellaneous steel other than designed building structural members as required to provide means of securing hangers, supports, etc., where piping does not pass directly below or cross structural elements.
- 3.8 Piping shall not be supported by the equipment to which it is connected. Support all piping so as to remove any load or stress from the equipment.
- 3.9 Where piping, etc., is routed vertically, approved riser clamps, brackets or other means shall be utilized at approximately 10'-0" center to center minimum. An approved adjustable base stand or fitting on concrete support base shall be utilized at the base of the vertical run.
- 3.10 Where piping is routed along walls, knee braced angle frames, etc. pipe brackets with saddles, clamps, and rollers mounted on structural brackets fastened to walls or columns shall be used.
- 3.11 Support all ceiling hung equipment with approved vibration isolators.
- 3.12 Where copper tubing is specified, hangers shall be of copper clad type when piping is uninsulated.
- 3.13 Uninsulated piping hung from above shall be supported with ring and clevis type pipe hangers. Uninsulated piping mounted on trapeze (when allowed) and wall bracket type support shall be held in place with U-bolts. U-bolts shall allow for axial movement in the piping.
- 3.14 All insulated piping shall be supported with clevis type and pipe roll hangers. Hangers shall be sized to allow the pipe insulation to pass through the hangers. Install insulation protection saddles at all hanger locations. Welded pipe saddles shall be installed at all hangers on piping 5" and larger. The pipe saddles shall be sized for the thickness of insulation used. Hangers shall fit snugly around outside of insulation saddles.

- 3.15 Under no conditions will perforated band iron or steel wire driven hangers be permitted.
- 3.16 Support steel and copper piping at a minimum of eight (8) foot intervals for piping 3" and smaller and ten (10) foot intervals for larger piping. Provide additional support at end of the branches and change of direction.
- 3.17 Ensure that all bolts and nuts are tightened.

END OF SECTION.

DIVISION 20 - MECHANICALSECTION 203100 - TESTING, BALANCING, LUBRICATION AND ADJUSTMENTSPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Engineer, or authorized representative, shall be notified by the Contractor twenty-four (24) hours in advance of any tests called for in these Specifications or required by others.
- 1.3 Only after written approval, signed by the Engineer, shall the Contractor apply insulation or paint or allow the work to be furred-in. This written approval, however, does not relieve the Contractor of the responsibilities for any failure during the guarantee period. The expense of all tests shall be borne by the Contractor, along with all temporary equipment, materials, gauges, etc. required for tests.
- 1.4 Contractor shall notify TAB Agency in writing that the domestic water system has been flushed, cleaned and ready for sterilization or sanitizing. No chemicals are to be added to this system until all balancing has been completed risk of contamination. The TAB firm is to properly notify all parties in writing when they have completed this portion of testing. If not properly coordinated, then the system will require additional sterilization and sanitizing at the Contractor's expense. Refer to PIPE, PIPE FITTINGS AND PIPE SUPPORT Specification Section.

PART 2 - HEATING, VENTILATING AND AIR CONDITIONING TESTING:

- 2.1 The test and balance of this system shall be by a Contractor who employs only the services of a certified AABC or independent NEBB firm whose sole business is to perform test and balance services.
- 2.2 The test and balance contractor shall bid directly to the Mechanical Contractor.
- 2.3 Mechanical Contractor shall provide all start-up documents to Test and Balance Contractor prior to any test and balance services.
- 2.4 The Mechanical Contractor shall test all piping before being insulated or concealed in any manner. Where leaks or defects develop, required corrections shall be made and tests repeated until systems are proven satisfactory. Water piping systems shall be subjected to a hydrostatic test as specified and shall be proven tight after a twenty-four (24) hour test.
- 2.5 All motors, bearings, etc. shall be checked and lubricated as required during start-up procedures. All automatic, pressure regulating and control valves shall be adjusted. Excessive noise or vibration shall be eliminated.
- 2.6 System balancing, where required, shall be performed only by persons skilled in this work. The system shall be balanced as often as necessary to obtain desired system operation and results.
- 2.7 All fan belts shall be adjusted for proper operation of fans.
- 2.8 Testing shall occur after completion of the ceiling systems installation.
- 2.9 All deficiencies observed by the Test and Balance Contractor shall be reported immediately to the Engineer and Mechanical Contractor.

- 2.10 Refer to Specification Section – CONTROLS – DIRECT DIGITAL for additional requirements.
- 2.11 Refer to Specification Section – GENERAL PROVISIONS – MECHANICAL for startup requirements.
- 2.12 Provide a preliminary test report to the Engineer immediately after the system is air balanced, or any initial phases are balanced. This report may be hand written. Any systems that are not found to operate within the design tolerances by the Test and Balance Contractor shall be immediately be reported to the Engineer via telephone call to attempt to determine a resolution while the Test and Balance Contractor is still on site. Additional compensation will not be accepted for additional trips.
- 2.13 Anticipate visiting the site again after the Engineer has reviewed the report. The Engineer may request up to two (2) additional site visits for onsite troubleshooting where additional measurements may be required.
- 2.14 For the purpose of placing the Heating, Ventilating and Air Conditioning systems in operation according to design conditions and certifying same, final testing and balancing shall be performed in complete accordance with AABC Standards for Total System Balance, 7th edition for air and hydronic systems as published by the Associated Air Balance Council.
- 2.15 THE FOLLOWING SYSTEMS SHALL BE TESTED AND BALANCED:
- The supply, return, outside and exhaust air duct systems associated with all OAs, AHUs, DHUs and ERVs. Provide static pressure profiles thru each system. Static pressure profiles shall include all sections from the return duct inlet and supply duct outlet of the fan coil unit. Show accurate representation of return, relief, outdoor and economizer damper locations. On units equipped with exhaust air fans; show location and profile of the exhaust fan.
 - Outside and exhaust air in each room to within 5% of design air flow rate.
 - Verify calibrations of the duct static pressure.
 - Balance chilled water pumps
 - Balance hot water pumps
 - Balance condenser pumps
 - Balance all supply and return air grilles to within 10% of design air flow rate.
 - Balance all exhaust air fans and record inlet static pressure.
- 2.16 Balance all units rated for 2,000 cfm unit such that the total air volume delivered does not exceed 2,000 cfm, otherwise the Contractor shall furnish and install a code compliant duct smoke detection system integrated into the building's system.
- 2.17 Balance the water flow rate of each air handling unit and outside air unit.
- 2.18 Instruments used for testing and balancing of air and hydronic systems shall have been calibrated within a period of six months prior to balancing. All final test analysis reports shall include a letter of certification listing instrumentation used and last date of calibration.
- 2.19 Test and Balance agency shall provide sizing of fan or motor sheaves required for proper balance. The Mechanical Contractor shall purchase and install all sheaves and belts as required. This includes new and existing equipment.
- 2.20 Three (3) copies of the complete test reports shall be submitted to the Consulting Engineer prior to final acceptance of the project. Preliminary test reports shall be submitted when requested.
- 2.21 The Contractor shall provide and coordinate work to provide sufficient time before final completion date so that tests and balancing can be accomplished and provide immediate labor and tools to make corrections when required without undue delay.

- 2.22 The Contractor shall put all heating, ventilating and air conditioning systems and equipment and rangehood system into full operation and shall continue the operation of same during each working day of testing and balancing.
- 2.23 The Test and Balance Contractor shall be present during the Engineer's final inspection of the building, or a separate project review date. The Engineer may request confirmation of the air balance report by asking for new measurements to be taken at that time. Any information in the test and balance report may be asked to be reconfirmed.

END OF SECTION.

22

DIVISION

PLUMBING

DIVISION 22 – PLUMBINGSECTION 220100 - PLUMBING SPECIALTIESPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall provide all equipment and specialties complete with trim required and connect in a manner conforming to the State Plumbing Code.
- 1.3 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of the rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- 1.4 All equipment and specialties shall be new. All equipment and specialties shall be installed as recommended by the manufacturer.
- 1.5 Prior to final inspection, test by operation at least twice, all equipment. Also, remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from equipment and specialties and thoroughly clean same.
- 1.6 All equipment and specialties shall be installed in a neat and workmanlike manner. Unacceptable workmanship shall be removed and replaced at the installing Contractor's cost.
- 1.7 Provide all drainage specialties indicated, specified and/or required to provide complete and acceptable removal of all storm, sanitary, waste, laboratory waste, etc. from the building and into approved receptors. Drainage specialties shall be on non-electrolytic conduction to the material to which they are connected. Drainage specialties shall be installed in a manner so as to insure no leakage of toxic or odorous gases or liquids and shall have traps and/or backflow preventers where required. Nor shall they allow backflow into other or existing systems.

PART 2 - CLEANOUTS:

- 2.1 CLEANOUTS: In addition to cleanouts indicated on the drawings, provide cleanouts in soil and waste piping and storm drainage at the following minimum locations:
 - At base of each stack.
 - At fifty (50) foot maximum intervals in horizontal lines.
 - At each change of direction of a horizontal line.
 - As required to permit rodding of entire system.
 - As required by current State Plumbing/Building Codes.
- 2.2 Water closets, mop sinks/basins and other fixtures with fixed traps shall not be accepted as cleanouts.
- 2.3 Cleanouts and/or test tees concealed in inaccessible pipe spaces, walls and other locations shall have an eight (8) inch by eight (8) inch (minimum) access panel or cover plates shall be set flush with finished floors and walls and shall be key or screw driver operable.

- 2.4 Access panels for cleanouts shall be of the Zurn 1460 series or equivalent by Josam or Wade. Where they are not to receive paint, they shall be polished bronze unless otherwise indicated where they are to receive paint or other finishes.
- 2.5 Cleanouts and access panels shall be sized so as to permit the entry of a full sized rodding head capable of one hundred percent circumferential coverage of the line served.
- 2.6 Provide a non-hardening mixture of graphite and grease on threads of all screwed cleanouts during installation.
- 2.7 Do not install cleanouts against walls, partitions, etc. where rodding will be difficult or impossible. Extend past the obstruction.
- 2.8 In finished walls, floors, etc., insure that cleanouts are installed flush with finished surfaces and, where required, grout or otherwise finish in a neat and workmanlike manner.
- 2.9 EXTERIOR CLEANOUTS (ECO): Provide exterior cleanouts where indicated for all sanitary and storm lines leaving the building within 5'-0" of building perimeter. Permanently locate all exterior cleanouts with 12"x12"x12" solid finished concrete marker slightly above grade in grass areas or flush in concrete or pavement areas. Label "CO". Zurn Z-1400-HD cleanout with tractor cover for exterior locations. Provide concrete supporting pad crowned to shed water.
- 2.10 Cleanouts shall be as manufactured by Zurn, Josam, Wade, Ancon, Jay R. Smith, similar to the following:
- Zurn Z-1440 or Z-1445 cleanout tee at base of exposed stack and at change in direction of exposed lines.
 - Zurn Z-1440 cleanout or Z-1445-1 cleanout tee where stacks are concealed in finished walls.
 - Zurn ZN-1400-T cleanout with scoriated top in finished concrete and masonry tile floors.
 - Zurn ZN-1400-Tx cleanout with square recessed top for VCT and linoleum finished floors.
 - Zurn ZN-1400-Z cleanout with round recessed top for poured floors.
 - Mueller D-731 or D-714, Nibco, Flage or equivalent for cleanouts in copper waste with cover plates and/or access panels listed for other cleanouts.
 - Threaded hex head type cleanouts of same materials as pipe for piping 2" and smaller.
 - Zurn cleanout with round top with adjustable retainer for carpet area. Install flush with carpet.

PART 3 – FLOOR DRAINS:

- 3.1 FLOOR DRAINS: Provide floor drains at locations indicated and/or as required by State Plumbing/Building Codes. Install in a neat and workmanlike manner. Install floor drains in strict accordance with manufacturer's recommendations and the State Plumbing and Building Codes. Coordinate locations with General Contractor to insure floor pitch to drain where required.
- 3.2 Insure by coordination with the General Contractor that spaces served with floor drains on all floors above the lowest level have a water seal extending at least three (3) inches from the floor. Also, for these locations, provide a 36"x36", four (4) pound sheet lead flashing sheet and clamping collar or a 30 mil chlorinated polyethylene shower pan liner. Lead pans shall be given a heavy coat of asphaltum on bottom and sides before installation and a heavy coat on any exposed surfaces. After installation, provide one ply of fifteen (15) pound roofing felt beneath each pan.
- 3.3 The floor drains shall be Zurn, Josam, Smith, Wade, Watts Drainage, Ancon, similar to the following:
- FD-1 - Zurn, ZN-511 floor drain with 9"dia. nickel bronze strainer, dura-coated cast iron deep sump with 4" bottom outlet, seepage pan and sediment bucket. Provide with trap primer connection.

PART 4 – FREEZEPROOF WALL HYDRANTS:

- 4.1 **FREEZEPROOF WALL HYDRANTS:** Provide code approved wall hydrants at each location indicated in a neat and workmanlike manner. Affix tight to walls and insure that the feed piping is on the heated side of the building insulation blanket. Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.
- 4.2 Wall hydrants shall be Zurn 1320 or equivalent, 3/4", with half-turn ceramic cartridge, encased, flush, non-freeze, anti-siphon, automatic draining wall hydrant with key lock and combination backflow preventer/vacuum breaker.
- 4.3 Mount all wall hydrants at least twenty (20) inches above finished exterior grade. Where this is not possible or practical, contact Engineer for direction.
- 4.4 Turn over for each hydrant, an operator key in an envelope labeled "Exterior Wall Hydrants" to Owner upon completion of the project. Where hydrants have lockable boxes, turn over an operator key for each in an envelope labeled "Exterior Wall Hydrant Locks" to Owner upon completion of project.

PART 5 – INTERIOR HOSE BIBBS AND DRAIN VALVES:

- 5.1 **HOSE BIBBS AND DRAIN VALVES:** Provide code approved hose bibbs and drain valves at each location indicated in a neat and workmanlike manner. Affix hose bibbs tight to walls. Provide all water supply specialties indicated, specified and/or required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.
- 5.2 **HOSE BIBBS (HB):** Provide code approved hose bibbs with vacuum breakers and male threaded spouts at each location indicated (toilet rooms, mechanical rooms, etc.). The hose bibbs shall be Woodford Model 24 (or equal) with loose key handle polished chrome finish, brass construction. Hose bibbs shall be mounted at eighteen (18) inches above finished floor. Do not install hose bibbs in spaces which do not have floor drains. Do not install hose bibbs in ADA accessible toilet stalls.
- 5.3 **DRAIN VALVES:** Install 3/4 inch bronze body drains, similar and equivalent to Nibco, No. 72 or 73, as indicated and at the following locations:
- At the low point and isolatable section of the plumbing system.
 - At each low point and isolatable section of the hydronic system.
 - At each isolatable pipe section.
 - At each water heater.
 - At each storage tank.
 - At each boiler.
 - At each heat pump.
 - At each water-to-water unit.
 - At each chiller.
 - At each pump suction.
 - Install a code approved vacuum breaker where installation on to domestic water system.

PART 6 – WATER HAMMER ARRESTORS (WHA):

- 6.1 **WATER HAMMER ARRESTORS (WHA):** Provide water hammer arrestors at each location indicated and/or as required to eliminate hydrostatic on the domestic water system. Install in an accessible location and in a neat and workmanlike manner. Provide all water supply specialties indicated, specified and/or

required for the complete installation. Install in accordance with the manufacturer's recommendations and the Building Code. Where required by the State Plumbing Code, install code approved vacuum breakers in each water supply specialty.

- 6.2 Water hammer arrestors shall be Zurn, Z-1700, Shoktrol, Smith, Josam, Wade or equivalent. Water hammer arrestors shall be stainless steel, bellows type. Field fabricated capped cylinders shall not be acceptable. Provide insulating unions where arrestors are of dissimilar material from the piping served (unless piping is non-conducting, such as ABS or PVC).
- 6.3 MULTIPLE FIXTURES – BRANCH LINE LESS THAN 20’ LONG: The preferred location for a Zurn Shoktrol is at the end of the branch line between the last two fixtures served when the branch lines do not exceed 20’ in length, from the start of the horizontal branch line to the last fixture supply on this line.
- 6.4 MULTIPLE FIXTURES – BRANCH LINE MORE THAN 20’ LONG: On branch lines over 20’ in length, use two Shoktrols whose capacities total the requirement of the branch. Locate one unit between the last and next to last fixture and the other unit approximately midway between the fixtures.
- 6.5 Provide at least one water hammer arrestor at all quick acting valve locations including:
 - Clothes Washers – Type “A”
 - Commercial Dishwashers – Type “B”
 - Sterilizers – Type “B”
 - Mop Basins, downstream of check valves – Type “A”
 - Flush valve fixtures – Type “B”, each toilet room with 1-3 flush valve fixtures shall have its own Type “B” water hammer arrestor.

6.6 ARRESTOR SCHEDULE:

| Mark | Zurn Model Z-1700 | Fixture Units | P.D.I. Size |
|----------|----------------------|------------------|----------------|
| Type “A” | #100 | 1-11 | A |
| Type “B” | #200 | 12-32 | B |
| Type “C” | #300 | 33-60 | C |
| Type “D” | #400 | 61-113 | D |

PART 7 - OTHER SPECIALTIES:

- 7.1 VACUUM BREAKERS AND BACK FLOW PREVENTERS: Where required by the Building Code, whether indicated or not, provide approved vacuum breakers or backflow preventers at the following locations.
 - Where domestic water system connects to a limited area fire protection system.
 - Where domestic water system connects to hydronic system.
 - At any threaded hose tap on the domestic water system.
 - At all mop basins, provide check valves to the hot and cold water supply upstream of the faucet.
- 7.2 ROOF FLASHINGS: All plumbing vents or other plumbing passing thru the roof shall be flashed as approved by the State Plumbing and Building Codes and as recommended by the roofing manufacturer and/or Contractor.

END OF SECTION.

DIVISION 22 - PLUMBINGSECTION 220200 - PLUMBING FIXTURES, FITTINGS AND TRIMPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall provide all fixtures complete with trim required and connect in a manner conforming to the State Plumbing Code.
- 1.3 The Contractor shall obtain exact centerline rough-in dimensions between partitions, walls, etc. as required for lay-out of the rough-in work. All work shall be roughed-in so that all exposed piping will be straight and true without bends or offsets.
- 1.4 All fixtures and trim shall be new. All fixtures and trim shall be installed as recommended by the manufacturer. All fixtures shall be set level and true and shall be grouted into finished walls, floors, etc. in a neat and workmanlike manner with an approved waterproof non-yellowing grout for such service. All fixtures and trim shall be installed in a neat and workmanlike manner. Unacceptable workmanship shall be removed and replaced at the installing Contractor's cost. Pay particular attention to flush valves and bracket concealed portion to building structure during rough-in. Loose, shaky flush valves, lavatories, etc. shall not be acceptable.
- 1.5 All public sinks and lavatories shall be provided with a point of use ASSE 1070 tempering mixing valve.
- 1.6 Handicapped accessible fixtures shall be mounted as recommended by the Building Code and ADA. Special Note for Handicap Grab Rails: Coordinate top of shower valves, flush valves, flush tank, etc., with location of grab rails as shown on the architectural plans. The Contractor shall install all items to allow for installation, removal and service without removal of the grab bar.
- 1.7 Fixture seats shall be Church model 2155CTJ, elongated open front less cover w/ JUST-LIFT, STA-TITE check hinge and DuraGuard Antimicrobial Agent, or approved equal.
- 1.8 All exposed piping, stops, traps, tailpieces, etc. shall be code approved chrome plated brass unless otherwise indicated or specified. Where acid resistant piping is indicated on the drawing or the specifications, all piping and ancillary components from the sink/lavatory to dilution basin shall be acid resistant as specified and required by code.
- 1.9 Water supplies shall connect through walls with stops and chrome plated escutcheons with set screws. In general, furnish drinking fountains, wall-hung lavatories and hose bibbs with manual loose key stop valves. For all other fixtures, furnish with manual permanent-key stop valves (i.e. sinks in casework, etc.). When in doubt, contact Engineer prior to installation.
- 1.10 Coordinate all stainless steel sinks with architectural casework shop drawings for appropriate fit. Do not order sinks until this has been coordinated. Change Orders will be immediately rejected for lack of coordination during construction.
- 1.11 Test for appropriate operation at least twice, ALL fixtures and trim including hands-free trim. Open all faucets and allow to run for fifteen (15) minutes, then remove all faucet aerators and thoroughly clean until smooth flow is obtained. Test by operation at least twice, adequate flow of water at flush valves including

appropriate adjustment of hands-free devices, faucets including appropriate adjustment of hands-free devices, hose bibbs, fixture drains, shower heads, etc.

- 1.12 Remove all stick-on labels, dirt, grease, other removable stampings, lettering, etc. from plumbing fixtures and thoroughly clean same.
- 1.13 ACCEPTABLE MANUFACTURERS: Subject to compliance with requirement's manufacturers offering plumbing fixtures and trim which may be incorporated in the work include only the following:
- 1.13.1 Plumbing Fixtures: American Standard, Kohler, Zurn, Sloan
- 1.13.2 Plumbing Trim: American Standard, Chicago Faucet, Kohler, Delta Commercial, T&S Brass, Just, Speakman, Zurn Aqua-Spec, Moen Commercial, Symmons
- 1.13.3 Flush Valves: Sloan, Zurn, Delany
- 1.13.4 Stainless Steel Sinks: Elkay, Just, Moen Commercial, Sterling
- 1.13.5 Mop Basins and Laundry Tubs: American Standard, Eljer, Fiat, Kohler, Mustee, Acorn, Zurn
- 1.13.6 Water Coolers: Elkay, Haws, Sunroc, Oasis, Halsey Taylor
- 1.13.7 Showers: Bradley, Symmons, Chicago Faucets, Speakman Company, Powers, Acorn, Aqua Bath, Florestone, Swanstone, Willoughby, Aquarius
- 1.13.8 Appliance Connection Boxes: Guy Gray, Oatley, Wolverine
- 1.13.9 Wash Fountains: Bradley, Acorn, Willoughby
- 1.13.10 Emergency/Safety Fixtures: Bradley, Acorn, Guardian, Haws
- 1.13.11 Fixture Seats: Bemis, Church, Olsonite
- 1.13.12 Fixture Carriers: Josam, Kohler, Tyler Pipe, Zurn, Wade, Smith, Watts
- 1.13.13 Lavatory, Sink, Mop Basin and Laundry Tub Strainers: American Standard, Elkay, Kohler, McGuire., Sloan, Zurn.
- 1.13.14 P-traps, Tailpieces, and Escutcheons: American Standard, Elkay, Kohler, McGuire, Moen Commercial, Sloan, Zurn.
- 1.13.15 P-trap Insulation covering for ADA Fixtures: IPS Corp., McGuire, Plumberex.
- 1.13.16 Water supplies and stops: American Standard, Elkay, Kohler, McGuire, Moen Commercial, Nibco, Sloan, Watts, Zurn,

PART 2 – PLUMBING FIXTURE SPECIFICATIONS:

- 2.1 Reference Plumbing Fixture Schedule for design basis.

END OF SECTION.

DIVISION 22 - PLUMBINGSECTION 220300 - PLUMBING EQUIPMENTPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- 1.3 The Contractor shall provide in complete working order the following plumbing equipment located as indicated and installed, connected and placed in operation in strict accordance with the manufacturer's recommendations. All equipment shall be factory painted and, where applicable, factory insulated and shall, where such standards exist, bear the label of the Underwriters Laboratory.
- 1.4 All equipment, material and labor warranties shall be furnished by the equipment supplier/vendor. All warranties begin on the date of Substantial Completion. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for special warranty requirements.
- 1.5 Review the Specification Section – REQUIRED SHOP DRAWINGS, ETC., and provide all documentations called for therein.
- 1.6 All plumbing equipment shall comply with the latest provisions of ASHRAE Standard 90.1 and all provisions of the International Energy Conservation Code.
- 1.7 Ensure that the equipment that is proposed to be furnish may be installed, connected, placed in operation and easily maintained at the location and in the space allocated for it.
- 1.8 Determine from the Bid Documents the date of completion of this project and insure that equipment delivery schedules can be met so as to allow this completion date to be met.
- 1.9 Through coordination with other Contractors, Vendors and Suppliers associated with this Project, this Contractor shall insure a complete, 100% functional, tested, inspected and approved systems. Claims for additional cost or change orders will immediately be rejected. Refer to Specification Section - ELECTRIC MOTORS, ETC. for additional requirements. All equipment shall be furnished for a single point electrical connection unless specifically excluded as a requirement.
- 1.10 Review the Specification Section - CONTROLS to determine automatic controls requirements through the Building Automation System.
- 1.11 Review the Specification Section – TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS.

PART 2 - GAS FIRED INSTANTANEOUS WATER HEATERS:

- 2.1 APPROVED MANUFACTURERS: Rheem, A.O. Smith, and Nortec.

- 2.2 CONSTRUCTION: Water heater(s) shall be internally mounted, on-demand, multiple point of use, gas fired, direct vent, water heaters designed certified to ANSI Z21.10.3 standard for gas-fired water heaters. Water heaters shall have copper heat exchanger, stainless steel burners, cast aluminum gas control valve/gas connection, and solid brass inlet and outlet water connections. Units shall have a stainless-steel secondary heat exchanger. Units shall be equipped with a factory installed, pre-charged condensate neutralizer.
- 2.3 PERFORMANCE: Water Units shall have BTU input range of 11,000 BTU/hr to 199,900 BTU/hr, a minimum recovery efficiency rating of 94%, a minimum water outlet capacity of 9.5 gallons per minute and minimum activation flow rate of 0.40 gpm and an operational minimum flow rate of 0.26 gpm.
- 2.4 CONTROL: Water heaters shall be microprocessor controlled and utilize a direct electronic ignition system with no standing pilot, fully modulating gas control valve, turbine water flow meter, automatic electro-mechanical water flow control valve, and water temperature thermistors to maintain outlet water temperature between +/- 2 degree Fahrenheit of setpoint temperature. Water heaters shall be provided with remote temperature thermostat with adjustable setpoint range of 100 degrees F -140 degrees F. A Commercial upgrade kit shall be provided and installed for 140 degrees F -185 degrees F applications. Units shall have diagnostic functions for servicing the equipment.
- 2.5 MANIFOLD: Water heaters shall be suitable for multiple unit electronic manifold installations. Units shall have the ability to be manifold electronically in configurations from 2-10 units. Temperature control and diagnostic functions for all water heaters in the manifold shall be controlled via a single remote temperature thermostat.
- 2.6 SAFETIES: Units shall incorporate the following safety devices: incomplete combustion sensing burner technology, film-type thermal overheat protection covering entire heat exchanger, flame failure lockout, internal freeze protection for ambient temperatures as low as -30 degrees F, and lockout protection in the event of a blocked flue.
- 2.7 START-UP: Manufacturer shall provide the services of a factory representative to aid in installing and starting the equipment. Two perfect bound Owner's manuals shall be furnished.
- 2.8 WARRANTY: Provide 3 year parts and labor warranty with, 5 year warranty on copper heat exchanger, 10 year warranty on pre-charged condensate neutralizer.

PART 3 – DOMESTIC WATER SOFTENER:

- 3.1 ACCEPTABLE MANUFACTURERS: Bruner, Culligan, Marlo, Permutit.
- 3.2 The water softening system shall reduce the hardness to less than 5 mg/La. The system shall be equal to a Marlo Twin Model MR-300-0 designed to handle a continuous flow rate of 165 gallons per minute at a pressure loss not exceeding 15 psi. The system will have a softening capacity of not less than grains of softening capacity per regeneration when a salt dosage of 60-150 pounds per tank is used.
- 3.3 Each softener resin tank will be 30 inches in diameter. The side shell height shall be sufficient to allow a minimum freeboard space of 50 percent of the resin bed depth for adequate expansion of the resin during backwashing. Tanks shall be designed for an operating pressure up to 120 psi and shall be manufactured of fiberglass reinforced polyester. The exterior side shell shall be reinforced by a continuous roving glass filament overwrap. The tanks shall be supported by a molded polypropylene structural base.
- 3.4 Each softener tank shall be equipped with a soft water collector and backwash water distributor consisting of 3 inches of underbed sand to ensure even distribution of water. Each softener tank shall be equipped with an upper distributor that distributes water laterally to ensure maximum water softening capacity.

- 3.5 Each softener tank shall be provided with 10 cubic feet of resin having a minimum exchange capacity of 200,000 grains per cubic foot when regenerated with 60 pounds of salt. The media shall be solid and not more than 4% through 40 mesh U.S. standard wet screen screening. The media shall contain no agglomerates, shells, plates, or other shapes that might interfere with the normal function of the water softener. The resin shall be manufactured to comply with the food additive regulations of the Food and Drug Administration.
- 3.6 A combination salt storage and brine tank, measuring 24 inches in diameter by 60 inches tall, with cover, shall be provided. The tank shall be molded of corrosion-proof, high-density polyethylene.
- 3.7 The tank shall be equipped with an elevated plate for brine collection and a chamber to house a brine valve assembly. The brine valve shall automatically open to admit brine to the resin tank during eduction and close automatically to prevent introduction of air into the resin tank. During refill, the brine valve shall regulate the flow of soft water into the brine tank, working with the timed refill feature of the softener control valve. Together these components shall admit the correct volume of water to the brine tank in accordance with the salt dosage settings on the control valve. The brine valve shall include a flat-operated safety shut-off valve, as a back-up to the time refill valve on the control, to prevent brine tank overflow.
- 3.8 The control valve shall be of all-brass construction and have 1 inch NPT inlet and outlet. It shall be motor driven, mechanically-activated design with six positions to accomplish the regeneration steps of backwash, brine draw-slow rinse, fast-rinse, refill and standby in addition to the service position. The control shall be fitted with a fixed orifice eductor nozzle and a self-adjusting backwash flow control.
- 3.9 Provide sampling cocks on piping for obtaining effluent water samples. Furnish complete testing kit for soap test method.
- 3.10 WARRANTY: The water softening equipment shall be warranted against failure due to faulty materials, workmanship, or corrosion for a period of one year from substantial completion. In addition, the fiberglass reinforced plastic tank shall be warranted for a period of five years.
- 3.11 EQUIPMENT START-UP: Prior to utilization of equipment, start-up service shall be performed by factory authorized representative. Utilize startup sheets provided by the manufacturer. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for additional requirements.
- 3.12 Provide four (4) hours of onsite training for this system. All training to occur after building completion. System shall function properly and O&M staff shall be able to operate the system prior to turnover.

PART 4 – SHELL & TUBE HEAT EXCHANGERS:

- 4.1 ACCEPTABLE MANUFACTURERS: Bell & Gossett, Taco, Armstrong.
- 4.2 Provide U-tube heat exchangers as indicated, of capacity as scheduled, and as specified herein.
- 4.3 Shell and tube, U-bend removable tube bundle, water in tubes, equipped with mounting legs.
- 4.4 MATERIALS:
- Shell - Steel.
 - Tubes - 3/4" O.D. copper.
 - Heads - Cast iron with "K" head for easy tube bundle removal.
 - Tube Sheets - Steel.
 - Tube Supports - Steel.

- 4.5 Provide bonnet head assembly to permit removal of tubes without affecting piping.
- 4.6 ASME Construction for 125 psi design pressure at 375°F.

END OF SECTION.

23

DIVISION

HVAC EQUIPMENT

DIVISION 23 - HVACSECTION 230200 - HVAC EQUIPMENTPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 The Contractor shall provide in complete working order the heating, ventilation and air conditioning equipment located as indicated and installed, connected and placed in operation in strict accordance with the manufacturer's recommendations. All equipment shall be factory painted and, where applicable, factory insulated and shall, where such standards exist, bear the label of the Underwriters Laboratory.
- 1.3 All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- 1.4 All equipment, material and labor warranties shall be furnished by the equipment supplier/vendor. All warranties begin on the date of Substantial Completion. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for special warranty requirements.
- 1.5 Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for minimum required Schedule of Values breakdown.
- 1.6 Review the Specification Section – REQUIRED SHOP DRAWINGS, ETC., and provide all documentations called for therein.
- 1.7 Each subcontractor shall be responsible for their own completion of System Verification Checklists/Manufacturer's Checklists. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for additional requirements. Factory startup is required for all HVAC equipment. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians and shall complete and submit start-up reports/checklists. This shall include the following:
- Outside Air Units
 - Air Handling Units
 - Variable Frequency Drives
 - Dehumidification Units
 - Chillers
 - Cooling Towers
 - Energy Recovery Units
- 1.8 All HVAC equipment shall comply with the latest provisions of ASHRAE Standard 90.1 and all provisions of the International Energy Conservation Code.
- 1.9 Ensure that the equipment that is proposed to be furnish may be installed, connected, placed in operation and easily maintained at the location and in the space allocated for it.

- 1.10 The contractor and vendor shall confirm connection sides for each piece of equipment specific to this project.
- 1.11 Determine from the Bid Documents the date of completion of this project and ensure that equipment delivery schedules can be met so as to allow this completion date to be met.
- 1.12 Through coordination with other Contractors, Vendors and Suppliers associated with this Project, this Contractor shall ensure a complete, 100% functional, tested, inspected and approved systems. Claims for additional cost or change orders will immediately be rejected. Refer to Specification Section - ELECTRIC MOTORS, ETC. for additional requirements. All equipment shall be furnished for a single point electrical connection unless specifically excluded as a requirement.
- 1.13 Review the Specification Section - CONTROLS to determine controls, including variable frequency drives, to be furnished. Where manufacturer's temperature controls are specified, they shall be in full compliance with NFPA 90A including automatic smoke shut down provisions.
- 1.14 Review the Specification Section – TESTING, BALANCING, LUBRICATION AND ADJUSTMENTS. For all belt driven equipment, provide final fan and motor sheaves as determined by the air balance contractor during project balancing phase. The mechanical contractor shall install any new sheaves and belts as required for balancing.

PART 2 – OUTSIDE AIR UNITS (OUTDOOR TYPE):

- 9.1 ACCEPTABLE MANUFACTURERS: Diakin, York, Carrier, Trane, AAON.
- 9.2 Provide factory built and factory tested air handling units of sizes, capacities and configurations as scheduled and as specified herein. Unit layout shall be dual path, providing one path for outside air with all components arranged in series as specified and providing one path for exhaust air with all components arranged in series as specified.
- 9.3 Provide factory installed external support kit on the base of the unit. Unit mounting devices not constructed of galvanized steel shall be chemically cleaned, coated with rust-inhibiting primer and finished with rust inhibiting enamel.
- 9.4 CASINGS:
 - 9.4.1 Unit shall be double wall foam injected constructed in all sections. Foil facing on insulation shall not be acceptable as a substitute for double wall construction. Insulate all sections with 2" thick foam injected insulation, 1 ½ lb per cubic foot density. All panels shall be solid on the interior and exterior. Insulation shall comply with NFPA 90A. Fiberglass insulation shall not be acceptable.
 - 9.4.2 Unit shall be constructed of a complete structural frame with removable panels. Removal of all exterior panels shall not affect the structural integrity of the unit. Installing Contractor shall be responsible to provide connection flanges and all other framework that is needed on unit to ensure that removals of unit's panels shall not affect structural integrity.
 - 9.4.3 All exterior panels and structural frames shall be constructed of G90-U galvanized steel. Casings not constructed of G90-U galvanized steel, casings with welds on interior and exterior surfaces that have burned through to exterior surfaces shall be chemically cleaned, coated with rust inhibiting primer and finished with rust inhibiting enamel.

- 9.4.4 Construct casing sections located upstream of the supply fan for operation at 4 inches water gauge negative static pressure and casing sections located downstream of the supply fan for operation at 6 inches water gauge positive static pressure.
- 9.4.5 All joints between exterior panels and structural frames shall have seals and gaskets with closed-cell foam gasketing for air seal and acoustical break.
- 9.4.6 As required for routine service access, unit shall be supplied with full height, galvanized, double wall, hinged, removable access doors. Access door shall have a full perimeter automotive type gasket to prevent air leakage, and Ventlock style handle that can be opened from unit interior. Doors shall open against system pressure. If access doors open against unit operating pressure, provide safety latches that allow access doors to partially open after the first handle movement and fully open after second handle movement. All handles shall operate easily without special tools.
- 9.5 FAN SECTIONS:
- 9.5.1 Provide fan sections with fan type as specified on drawings designed and suitable for class or service indicated. Fan sections shall have full height, double wall hinged, removable access doors on drive side for inspection and maintenance of internal components. Fan sections with plug fans shall have galvanized expanded metal access door guards to prevent unauthorized entry into fan sections when access doors are opened.
- 9.5.2 Mount fans on isolation bases. Internally mount motors on same isolation bases and internally isolate fans and motors with a minimum of 2-inch spring isolators. Provide adjustable motor base, adjusted with mounting bolts, to provide variation in center distance. Provide locking nuts, or similar devices, to secure base in proper position. Install flexible canvas ducts between fan and casings to ensure complete isolation. Flexible canvas ducts shall comply with NFPA 90A. Fan and motor assembly shall be weighed at the manufacturer's factory for isolator selection. Vibration shall be measured at each fan shaft bearing in horizontal, vertical and axial directions. All fans shall have pillow block bearings with minimum L-50 200,000 hour rating. Provide grease lubricated fan bearings with externally accessible fittings for lubrication. Extend both grease lubrication fittings to drive side of unit with plastic tubes and zerk fittings rigidly attached to drive side bearing support.
- 9.5.3 Motors shall be 3 phase ODP with NEMA frame and 1.15 service factor. Motor base shall be adjustable. Motor brake horsepower shall not exceed scheduled values. Fan brake horsepower shall not exceed 85% of motor horsepower. All motors shall comply with EPACT efficiency requirements. Refer to Specification Section – ELECTRIC MOTORS, ETC. for more requirements. Fan sections controlled by variable frequency drives and shall be factory installed. Refer to Specification Section - CONTROLS for all VFD specification requirements.
- 9.6 COIL SECTIONS AND DRAIN PANS:
- 9.6.1 Provide double wall casing for coil sections. Inside surfaces exposed to the air stream shall be constructed of stainless steel. Design internal structure of coil section to allow for removal of coils. Provide suitable baffles to assure no air bypass around coils. Condensate drain pans and coil casing and all fasteners shall be constructed of stainless steel. Insulate coil section casings and drain pans as prior specified.
- 9.6.2 All coils shall be tested at 200 psig air pressure while submerged in water. Coil performance shall be certified in accordance with ARI Standard 410. All coils shall have stainless steel casings. Construct coil headers of round copper pipe or cast iron. Clearly label supply and return headers on the outside of the units such that the direction of coil water flow is counter to the direction of air flow. If two or more coils are stacked in the unit, install intermediate drain pan channels between the coils to drain condensate to main drain pans without flooding lower coils or passing condensate through the air stream.

- 9.6.3 Provide type 304 sealed stainless steel drain pans. Encase insulation between exterior and interior walls. Drain pans shall be sloped in two planes; cross break interior pans and pitch toward drain connections to ensure complete condensate drainage. Drain pans shall be installed under the complete cooling coil section. All drain pan connections will be to the side of the unit to ensure proper trapping. Units without 2-way sloped drain pans shall coat drain pans with anti-microbial treatment.
- 9.7 DAMPERS: Provide internally mounted ultra low leak outside air dampers as specified on drawings. Dampers shall be double-skin airfoil design. Construct damper blades and damper frames of galvanized steel. Blades shall rotate on stainless steel sleeve bearings. Leakage rate shall not exceed 5 CFM/square foot at one inch water gauge and 9 CFM/square foot at 4 inches water gauge.
- 9.8 ENERGY RECOVERY SECTION: Manufacturers: Thyvent, Fresh Air Solutions, Semco, Novell-aire, XETEX. Energy Recovery Modules shall be installed in casing structure to match the OA unit construction throughout. A removable panel shall be provided to access the energy recovery cassette for service and inspection. Energy recovery wheel shall be mounted in a slide out cassette. A wiring box shall be provided for permanent connection of a power source. The Energy Recovery Cassette shall contain a 4 Angstrom total energy recovery wheel for sensible and latent energy recovery. A wheel drive motor having permanently sealed ball bearings shall be provided with plug-in connection to a receptacle mounted within the cabinet. Provide the ERW with a factory installed starter/disconnect. The total enthalpy wheel shall be supplied by the module manufacturer and be constructed of a light weight polymer material with a permanently bonded silica gel desiccant coating. Eight energy transfer sections shall be removable from the energy recovery wheel without the use of special tools. The units shall not require a condensation pan. Energy transfer ratings must be ARI Certified to Standard 1060 and bear the ARI certification symbol for ARI Air-to-Air Energy Recovery Ventilation Equipment Certification Program based on ARI 1060.
- 9.9 FILTERS: Filters shall be 2" thick, 30% efficient Merv 8, pleated and disposable. The filter pressure drop shall be 0.28" at 500 fpm face velocity. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2. Provide filter boxes with either hinged access doors at each end. Provide racks to receive filters in either flat or angle type pattern. Provide air filters to fit in filter box of the type scheduled on the drawings. Sizes and quantities shall be per the manufacturer's recommendations. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for Temporary Use of Equipment Requirements and filter quantities.
- 9.9.1 Disposable Filter Media: Filter Media shall be 2" thick fiberglass Air Filter Media Pads with an initial maximum pressure drop of 0.20"wg @ 500 fpm.
- 9.9.2 Retainer Frame and Backing Wire Frame: Provide for each filter to support the disposable filter media. Products shall be factory assembled. Retainer Frame shall be 10 gauge minimum and shall be provided with additional angled support prongs to prevent sagging filter pad. Frame shall be 18 gauge minimum and shall have flush mitered corners. Frames shall also be provided with 16 gauge galvanized 1x1 welded wire support backing.
- 9.10 EQUIPMENT START-UP: Prior to utilization of equipment, start-up service shall be performed by factory authorized representative. Utilize startup sheets included in the Specification Section GENERAL PROVISIONS - MECHANICAL. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for additional requirements.
- 9.11 Provide eight (8) hours of onsite training for this system. All training to occur after building completion. System shall function properly and O&M staff shall be able to operate the system prior to turnover.

PART 3 – INDOOR AIR HANDLING UNITS:

- 3.1 ACCEPTABLE MANUFACTURERS: Daikin, York, Carrier, Trane, AAON.

- 3.1.1 Provide factory built and factory tested air handling units of sizes, capacities and configurations as scheduled and as specified herein. Unit layout shall be dual path, providing one path for outside air with all components arranged in series as specified and providing one path for exhaust air with all components arranged in series as specified.
- 3.1.2 Provide factory installed external support kit on the base of the unit. Unit mounting devices not constructed of galvanized steel shall be chemically cleaned, coated with rust-inhibiting primer and finished with rust inhibiting enamel.
- 3.2 CASINGS:
- 3.2.1 Unit shall be double wall foam injected constructed in all sections. Foil facing on insulation shall not be acceptable as a substitute for double wall construction. Insulate all sections with 2" thick foam injected insulation, 1 ½ lb per cubic foot density. All panels shall be solid on the interior and exterior. Insulation shall comply with NFPA 90A. Fiberglass insulation shall not be acceptable.
- 3.2.2 Unit shall be constructed of a complete structural frame with removable panels. Removal of all exterior panels shall not affect the structural integrity of the unit. Installing Contractor shall be responsible to provide connection flanges and all other framework that is needed on unit to ensure that removals of unit's panels shall not affect structural integrity.
- 3.2.3 All exterior panels and structural frames shall be constructed of G90-U galvanized steel. Casings not constructed of G90-U galvanized steel, casings with welds on interior and exterior surfaces that have burned through to exterior surfaces shall be chemically cleaned, coated with rust inhibiting primer and finished with rust inhibiting enamel.
- 3.2.4 Construct casing sections located upstream of the supply fan for operation at 4 inches water gauge negative static pressure and casing sections located downstream of the supply fan for operation at 6 inches water gauge positive static pressure.
- 3.2.5 All joints between exterior panels and structural frames shall have seals and gaskets with closed-cell foam gasketing for air seal and acoustical break.
- 3.2.6 As required for routine service access, unit shall be supplied with full height, galvanized, double wall, hinged, removable access doors. Access door shall have a full perimeter automotive type gasket to prevent air leakage, and Ventlock style handle that can be opened from unit interior. Doors shall open against system pressure. If access doors open against unit operating pressure, provide safety latches that allow access doors to partially open after the first handle movement and fully open after second handle movement. All handles shall operate easily without special tools.
- 3.3 FAN SECTIONS:
- 3.3.1 Provide fan sections with fan type as specified on drawings designed and suitable for class or service indicated. Fan sections shall have full height, double wall hinged, removable access doors on drive side for inspection and maintenance of internal components. Fan sections with plug fans shall have galvanized expanded metal access door guards to prevent unauthorized entry into fan sections when access doors are opened.
- 3.3.2 Mount fans on isolation bases. Internally mount motors on same isolation bases and internally isolate fans and motors with a minimum of 2-inch spring isolators. Provide adjustable motor base, adjusted with mounting bolts, to provide variation in center distance. Provide locking nuts, or similar devices, to secure base in proper position. Install flexible canvas ducts between fan and casings to ensure complete isolation. Flexible canvas ducts shall comply with NFPA 90A. Fan and motor assembly shall be weighed at the

manufacturer's factory for isolator selection. Vibration shall be measured at each fan shaft bearing in horizontal, vertical and axial directions. All fans shall have pillow block bearings with minimum L-50 200,000 hour rating. Provide grease lubricated fan bearings with externally accessible fittings for lubrication. Extend both grease lubrication fittings to drive side of unit with plastic tubes and zerk fittings rigidly attached to drive side bearing support.

- 3.3.3 Motors shall be 3 phase ODP with NEMA frame and 1.15 service factor. Motor base shall be adjustable. Motor brake horsepower shall not exceed scheduled values. Fan brake horsepower shall not exceed 85% of motor horsepower. All motors shall comply with EPACT efficiency requirements. Refer to Specification Section – ELECTRIC MOTORS, ETC. for more requirements. Fan sections controlled by variable frequency drives and shall be factory installed. Refer to Specification Section - CONTROLS for all VFD specification requirements.
- 3.4 COIL SECTIONS AND DRAIN PANS:
- 3.4.1 Provide double wall casing for coil sections. Inside surfaces of chilled water coil sections exposed to the air stream shall be constructed of stainless steel. Design internal structure of coil section to allow for removal of coils. Provide suitable baffles to assure no air bypass around coils. Condensate drain pans and chilled water coil casing and all fasteners shall be constructed of stainless steel. Insulate coil section casings and drain pans as prior specified.
- 3.4.2 All coils shall be tested at 200 psig air pressure while submerged in water. Coil performance shall be certified in accordance with ARI Standard 410. All coils shall have chilled water coils stainless steel casings. Hot water coils shall have mill galvanized casings. Construct coil headers of round copper pipe or cast iron. Clearly label supply and return headers on the outside of the units such that the direction of coil water flow is counter to the direction of air flow. If two or more coils are stacked in the unit, install intermediate drain pan channels between the coils to drain condensate to main drain pans without flooding lower coils or passing condensate through the air stream.
- 3.4.3 Provide type 304 sealed stainless steel drain pans. Encase insulation between exterior and interior walls. Drain pans shall be sloped in two planes; cross break interior pans and pitch toward drain connections to ensure complete condensate drainage. Drain pans shall be installed under the complete cooling coil section. Units with heating coils shall have a drain pan under the complete heating coil segment to ensure proper drainage during cleaning. All drain pan connections will be to the side of the unit to ensure proper trapping. All drain pan connections will be to the side of the unit to ensure proper trapping. Units without 2-way sloped drain pans shall coat drain pans with anti-microbial treatment.
- 3.5 FILTERS: Filters shall be 2" thick, 30% efficient Merv 8, pleated and disposable. The filter pressure drop shall be 0.28" at 500 fpm face velocity. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2. Provide filter boxes with either hinged access doors at each end. Provide racks to receive filters in either flat or angle type pattern. Provide air filters to fit in filter box of the type scheduled on the drawings. Sizes and quantities shall be per the manufacturer's recommendations. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for Temporary Use of Equipment Requirements and filter quantities.
- 3.6 DAMPERS: Provide internally mounted ultra low leak outside air dampers as specified on drawings. Dampers shall be double-skin airfoil design. Construct damper blades and damper frames of galvanized steel. Blades shall rotate on stainless steel sleeve bearings. Leakage rate shall not exceed 5 CFM/square foot at one inch water gauge and 9 CFM/square foot at 4 inches water gauge.
- 3.8 AIR BLENDER: The air blender shall be constructed of the rotary design with radial blades. Blender shall have the proper distances upstream and downstream to provide minimum mixing effectiveness of 75% when mixing 50% outdoor air and 50% return air at 50 degree F initial inlet temperature differential. Unit shall mix two or more air streams of different temperatures to within a range of 6 degrees F standard

deviation of theoretical mixed air temperature and provide a more uniform air velocity contour entering a downstream filter or coil bank. Construct blender of aluminum. Unit panels shall be double wall construction as specified in the CASINGS paragraph of this section. A hinged access door shall be provided in the air blender section, down stream of the actual blender. The door shall be full height, insulated double-wall, with baked-on enamel dogged fasteners to provide airtight compression of the perimeter gasket. The door shall be lift-off type, removable at hinge pin to provide maximum service access.

- 3.9 EQUIPMENT START-UP: Prior to utilization of equipment, start-up service shall be performed by factory authorized representative. Utilize startup sheets provided by the manufacturer. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for additional requirements.
- 3.10 Provide eight (8) hours of onsite training for this system. All training to occur after building completion. System shall function properly and O&M staff shall be able to operate the system prior to turnover.

PART 4 – HIGH EFFICIENCY CONDENSING BOILERS

- 9.12 ACCEPTABLE MANUFACTURERS: Lochinvar, CleaverBrooks.
- 9.13 CONSTRUCTION: Boiler modules shall be natural gas fired, condensing fire tube design with a modulating forced draft power burner and positive pressure vent discharge.
- 9.14 MODULATING AIR/FUEL VALVE and BURNER: The Boiler burner shall be capable of a 20 to 1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall be nozzle mix design, with spark ignition and flame rectification. The burner head shall be cast stainless steel. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and natural gas input. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage. The linkage shall not require any field adjustment.
- 9.15 PRESSURE VESSEL/HEAT EXCHANGER:
- 9.15.1 The boiler shall be capable of handling return water temperatures down to 40 F without any failure due to thermal shock or fireside condensation. The heat exchanger shall be ASME stamped for a working pressure not less than 150 psig. The pressure vessel shall have a maximum water volume of 30 gallons. The boiler water pressure drop shall *not exceed* 2 psig at 180 gpm. The boiler water connections shall be 4" flanged 150 lb. ANSI rated. The pressure vessel is constructed of SA53 carbon steel, with a 0.25 in. thick wall and 0.50 in. thick upper head. Inspection openings in the pressure vessel & shall be in accordance with ASME Section IV pressure vessel code.
- 9.15.2 The boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases. The heat exchanger shall be constructed entirely of 316L stainless steel fire tubes and tube sheets with a one-pass combustion gas flow design. Hybrid designs or heat exchangers utilizing dissimilar metals or any non-ferrous metals shall not be acceptable. The fire tubes shall be 5/8 in. OD with no less than 0.065 in. wall thickness. The upper and lower stainless steel tubesheet shall be no less than 0.313 in. thick. The pressure vessel/heat exchanger shall be welded construction. The heat exchanger shall be ASME stamped for a working pressure not less than 150 psig. Access to the tubesheets and heat exchanger is available by burner and exhaust manifold removal. Minimum access opening shall be no less than 13.5 in. diameter.
- 9.16 EXHAUST MANIFOLD: Refer to Specification Section SHEETMETAL positive pressure venting specification. The exhaust manifold shall have a gravity drain for the elimination of the condensation with collecting reservoir.

- 9.17 BOILER CONTROLS: The boiler control system shall be segregated into three components: Control Panel, Power Box, and Input/Output Connection Box. The entire system shall be Underwriters Laboratories Recognized.
- 9.17.1 The control panel shall consist of 6 individual circuit boards utilizing surface-mount technology, in a single enclosure. These circuit boards shall be defined as follows: display board incorporating LED display to read temperature, and a VFD display module for all message annunciation; CPU board which houses all control functions; electric low water cutoff board with test and manual reset functions; power supply board; ignition /stepper board incorporating flame safeguard control; and connector board. Each board shall be individually field replaceable. The combustion safeguard/flame monitoring system shall utilize spark ignition and a rectification type flame sensor. The control panel hardware shall support both RS-232 and RS-485 remote communications. The controls shall annunciate boiler & sensor status and include extensive self-diagnostic capabilities that incorporates a minimum of 8 separate status messages and 34 separate fault messages.
- 9.17.2 The control panel shall incorporate three self-governing features designed to enhance operation in modes where it receives an external control signal by eliminating nuisance faults due to over-temperature, improper external signal or loss of external signal. These features are called: Setpoint High Limit, Setpoint Low Limit, and Failsafe Mode. Setpoint High Limit allows for a selectable maximum boiler outlet temperature and acts as temperature limiting governor. It is a PID function that automatically limits firing rate to maintain outlet temperature within a 0 to 10 degree selectable band from the desired maximum boiler outlet temperature. Setpoint Low Limit allows for a selectable minimum operating temperature.
- 9.17.3 Failsafe Mode allows the boiler to switch its mode to operate from an internal setpoint if its external control signal is lost, rather than shut off. This is a selectable mode; hence the control can be set to shut off the unit upon loss of external signal if so desired.
- 9.17.4 The boiler control system shall incorporate the following features for system interface: system start temperature feature; pump delay timer; auxiliary start delay timer; auxiliary temperature sensor; mA output feature which allows for simple monitoring of either temperature setpoint, outlet temperature, or fire rate; remote interlock circuit; delayed interlock circuit; and fault relay for simple remote fault alarm.
- 9.17.5 Each boiler shall utilize an electric single seated safety shutoff valve with proof of closure switch in its gas train and incorporate dual over-temperature protection with manual reset in accordance with ASME Section IV and CSD-1.
- 9.18 TEMPERATURE CONTROL MODES:
- 9.18.1 The boilers shall operate in the control modes listed below:
- Indoor/Outdoor Reset
 - Boiler Management System (BMS)
- 9.18.2 The first six control modes refer to independent boiler settings, while the last two control modes refer to banks of boilers operated as a system by supplied BMS. The BMS shall be programmed to operate the entire bank of boilers in either of the first four control modes.
- 9.19 INDOOR/OUTDOOR RESET:
- 9.19.1 Boiler shall include integral factory wired operating controls to control all operation and energy input of the boiler plant. The system shall be comprised of a microprocessor-based control utilizing pulse width modulation for bumpless transfer of header temperature. The controller shall have the ability to vary boiler input throughout its full range to maximize the condensing capability of the boiler and without header temperature swings.

- 9.19.2 The boiler will operate to vary header temperature setpoint on an inverse ratio in response to outdoor temperature to control discharge temperature $\pm 2^{\circ}\text{F}$. Unit shall operate with an Inverse Efficiency Curve, with known Part Load Value Efficiencies. Maximum efficiency shall be achieved at minimum firing input. Reset ratio shall be fully field adjustable from 0.3 to 3.0 in operation. The boiler shall have LCD display for monitoring of all sensors and interlocks.
- 9.19.3 The outdoor air sensor and supply water temperature sensor shall be furnished with the boiler package and installed by the Contractor.
- 9.20 BOILER MANAGEMENT SYSTEM (BMS):
- 9.20.1 The Boiler Manufacturer shall supply as part of the boiler package a completely integrated Boiler Management System to control all operation and energy input of the multiple boiler heating plant. The Boiler Management System shall be comprised of a microprocessor based control. The BMS controller shall have the ability to operate up to 32 boilers per BMS panel.
- 9.20.2 The controller shall have the ability to vary the firing rate and energy input of each individual boiler throughout its full modulating range to maximize the condensing capability and thermal efficiency output of the entire heating plant. The BMS shall control the boiler outlet header temperature within $\pm 2^{\circ}\text{F}$. The controller shall be a PID type controller for accurate temperature control with excellent variable load response. The BMS controller shall provide contact closure for auxiliary equipment such as system pumps and combustion air inlet dampers based upon outdoor air temperature.
- 9.20.3 When set on Internal Setpoint Mode, temperature control setpoint on the BMS shall be fully field adjustable from 50°F to 190°F in operation. When set on Indoor/Outdoor Reset Mode, the BMS will operate on an adjustable inverse ratio in response to outdoor temperature to control the main header temperature. Reset ratio shall be fully field adjustable from 0.3 to 3.0 in operation.
- 9.20.4 The BMS controller shall have a LCD display for monitoring of all sensors and interlocks. Non-volatile memory backup of all control parameters shall be internally provided as standard. The controller will automatically balance the sequence of operating time on each module by a first-on first-off mode and provide for setback and remote alarm contacts. Connection between central BMS system and individual modules shall be twisted pair low voltage wiring, with the boilers 'daisy-chained' for ease of installation.
- 9.21 CONTROLS INTEROPERABILITY: The control panel and the BMS shall utilize a BACnet gateway, however the manufacturer shall coordinate the details of this interface with the Temperature Controls Contractor prior to bid and prior to the shipment of the boilers. This coordination shall be documented in writing to the Owner and Engineer.
- 9.22 SECONDARY BOILER PUMPS: Provide each boiler with a variable speed boiler pump with built in speed controller. The boiler pump shall operate with the boiler controls to maintain boiler temperature rise at a designated temperature. Boiler controller shall send 0-10VDC signal to control pump speed. Pump shall have a digital display, stainless steel shaft, composite impeller, cast iron housing, pump status indicator and alarm contacts.
- 9.23 INSTALLATION:
- 9.23.1 All aspects of installation of Boiler Plant shall be in strict accordance with manufacturer's instructions. The vent and air intake system must conform to all manufacturers' recommendations and shall utilize UL listed stainless steel AL-29-4C Positive Pressure for the vent and PVC for the intake. The vent must be sized in accordance with boiler manufacturer's recommendations. Prior to the bid, the boiler manufacturer and Contractor shall confirm the appropriate vent and intake sizes according to the manufacturer's recommendation. Change orders will not be accepted for increases in sizes after the bid.

- 9.23.2 Boiler plant piping shall be field constructed of materials as specified. Each boiler shall have individually isolating shutoff valves for service and maintenance. Each boiler shall require a minimum gas pressure of 7"W.C. (FM gas train) at 1,000 scfh (full load rated capacity). Each boiler shall be provided with an individual supply gas regulator for proper gas regulation with a 1-1/4" NPT connection.
- 9.24 WARRANTY:
- 9.24.1 The boiler manufacturer shall provide a complete unit parts and labor warranty for one year from substantial completion.
- 9.24.2 Beginning at the expiration of the one year parts and labor, the Owner shall be provided with a non-prorated 7 year warranty against failure due to condensate corrosion, thermal stress, mechanical defects or workmanship. The six individual circuit boards of the control panel assembly shall carry a 2 year warranty against failure due to defective materials or workmanship.
- 9.25 EQUIPMENT START-UP: Prior to utilization of equipment, start-up service shall be performed by factory authorized representative. Utilize start-up sheets provided by the manufacturer. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for additional requirements.
- 9.26 Provide eight (8) hours of onsite training for this system. All training shall occur after building completion. Systems shall function properly and O&M staff shall be able to operate the system prior to turnover.

PART 5 – OA VARIABLE AIR VOLUME TERMINAL BOXES:

- 5.1 ACCEPTABLE MANUFACTURERS: ETI, Titus, Carrier, JCI/York, Price, Daikin, Nailor Industries.
- 5.1.1 Terminals shall be certified by ARI and bear the ARI 880 seal.
- 5.1.2 Terminals shall be constructed of not less than 22-gauge galvanized steel, able to withstand a 125-hour salt spray test per ASTM B-117. The terminal casing shall be mechanically assembled (spot-welded casings are not acceptable). Terminal shall include control enclosure and hanger brackets. The terminal shall be provided with a removable bottom access panel.
- 5.1.3 Casing shall be insulated with ½” thick fiberglass insulation, rated for a maximum air velocity of 5000 f.p.m. Maximum thermal conductivity shall be 0.24 (BTU · in) / (hr · ft² · °F). Insulation must meet all requirements of ASTM C1071 (including C665), UL 181 for erosion, and carry a 25/50 rating for flame spread/smoke developed per ASTM E-84, UL 723 and NFPA 90A. Raw insulation edges on the discharge of the unit must be covered with metal liner to eliminate flaking of insulation during field duct connections. Simple “buttering” of raw edges with an approved sealant is not acceptable. Insulation shall be covered with scrim backed foil facing. All insulation edges shall be covered with foil or metal nosing. Insulation shall meet ASTM C1136 for mold, mildew, and humidity resistance. All appurtenances including control assemblies and control enclosures, shall not extend beyond the top and bottom of the unit casing. At an inlet velocity of 2000 f.p.m., the static pressure drop across the basic terminal shall not exceed .08” W.G. for all unit sizes.
- 5.1.4 Additionally, the air terminals shall be double wall insulated, foil faced.
- 5.1.5 The primary air valve shall consist of a minimum 22-gauge cylindrical body that includes embossment rings for rigidity. The damper blade shall be connected to a solid shaft by means of an integral molded sleeve which does not require screw or bolt fasteners. The shaft shall be manufactured of a low thermal conducting composite material, and include a molded damper position indicator visible from the exterior of the unit. The damper shall pivot in self lubricating bearings. The damper actuator shall be mounted on the exterior of the terminal for ease of service. The valve assembly shall include internal mechanical stops for both full open and closed positions. The damper blade seal shall be secured without use of adhesives. The air valve leakage shall not exceed 1% of maximum inlet rated airflow at 3” W.G. inlet pressure.
- 5.1.6 The differential pressure airflow sensor shall traverse the duct along two perpendicular diameters. Cylindrically shaped inlets shall utilize the equal cross-sectional area or log-linear traverse method. Single axis sensor shall not be acceptable. A minimum of 12 total pressure sensing points shall be utilized. The total pressure inputs shall be averaged using a pressure chamber located at the center of the sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. The sensor shall output an amplified differential pressure signal that is at least 2.5 times the equivalent velocity pressure signal obtained from a conventional pitot tube. The sensor shall develop a differential pressure of 0.03” W.G. at an air velocity of <450 FPM. Brass balancing taps and airflow calibration charts shall be provided for field airflow measurements. Terminal shall have access door for inspection and cleaning.
- 5.1.7 Terminal shall include an integral, 2-row (minimum), hot water coil where indicated on the plans. The coil shall be manufactured by the terminal unit manufacturer and shall have a minimum 22-gauge galvanized sheet metal casing. Coil to be constructed of pure aluminum fins with full fin collars to assure accurate fin spacing and maximum tube contact. Fins shall be spaced with a minimum of 10 per inch and mechanically fixed to seamless copper tubes for maximum heat transfer. Each coil shall be hydrostatically tested at a minimum of 450 PSIG under water, and rated for a maximum 300 PSIG working pressure at 200°F.

PART 6 – VERTICAL & CLASSROOM AIR HANDLING UNITS (VAHUs/CAHUs):

6.1 GENERAL

- 6.2 ACCEPTABLE MANUFACTURERS: Seresco, Pool Pak, or Desert Aire, Dectron
- 6.3 Provide factory built and factory tested dehumidification system as indicated, of sizes and capacities as scheduled, and as specified herein.
- 6.4 Provide Owner with copies of complete controls software, licenses, cables, etc. for full connection to the system.
- 6.5 The unit shall be specifically designed, manufactured and tested for enclosed swimming pool duty. Field-assembled or modified, standard, commercial grade equipment is not acceptable. Complete unit shall be suitable for indoor or outdoor, weatherproof mounting.
- 6.6 The complete unit shall be listed by an industry recognized, third-party, safety code agency under the title of "Special Purpose Air Conditioners" and carry the appropriate label.
- 6.7 Manufacturer shall have a minimum of five-plus years prior experience making similar equipment as described in this specification.
- 6.8 It is the intent of this section of the specifications to provide a complete, operable, adjusted natatorium dehumidification system as shown and scheduled on the plans.
- 6.9 PRINCIPLE OF OPERATION
- 6.9.1 The unit shall control space temperature and relative humidity, pool water temperature and shall provide ventilation. Warm moist air from the natatorium is drawn over the evaporator coil by the return fan and latent and sensible heat is removed from the air. The heat captured by this process and the heat generated from the compressor power consumption are absorbed by a mechanical refrigeration system.
- 6.9.2 The code required amount of ventilation air is introduced between the evaporator and reheat condenser. The mixed air is drawn over a reheat condenser coil and auxiliary heating coil by the supply fan.
- 6.9.3 The refrigeration system may be activated if any of the following occur:
- Space temperature drops below the set point
 - Space relative humidity rises above the set point
 - Space temperature rises above the set point
- 6.9.4 The unit shall monitor space and outside air temperature, space relative humidity, pool water temperature and building surface temperature.
- 6.9.5 The thermal energy absorbed by the refrigeration system is distributed as follows:
- 6.9.6 First priority is given to maintaining the natatorium space temperature. No supplementary space heating system external to the unit is required.
- 6.9.7 Second priority is given to maintaining the pool water temperature.
- 6.9.8 All heat is then transferred to a Remote Air-Cooled Condenser.
- 6.10 CABINET
- 6.10.1 Cabinet Construction: All cabinet 16, 20 and 24 gauge sheet metal shall be galvanized G90 steel or Galvalume™ alloy with mill-applied zinc phosphate primer followed by an exterior grade white silicone

modified polyester top coat. The sheet metal is engineered to form a cabinet with maximum strength and rigidity. All seams shall be caulked with silicone to prevent air and water leakage or infiltration

- 6.10.2 Base Rails: The cabinet shall have a base frame comprised of 2 layers of 10 gauge mill galvanized G90 steel. Lifting lugs shall be provided on the base frame for rigging the system
- 6.10.3 The cabinet walls shall be of double-wall construction using 20 gauge pre-painted steel with a fully painted inner metal liner and 2 inches of fiberglass insulation
- 6.10.4 The cabinet floor shall be comprised of a 16-gauge galvanized steel panel with a 20-gauge pre-painted steel inner liner, 2-inch double wall engineered with structural bending for maximum rigidity and be mechanically fastened to the base frame of the unit
- 6.10.5 The cabinet roof shall be 20-gauge pre-painted steel, 2-inch double wall engineered with structural bending for maximum rigidity and be mechanically fastened to the base walls of the unit
- 6.10.6 The cabinets shall be mechanically assembled with stainless steel 5/32" sealed blind rivets. Where bolts are required bright zinc plated bolts shall be used
- 6.10.7 Access doors shall be supported on multiple hinges, held shut by compression latches for quick access. Doors shall be provided for entrance to all sections housing components requiring routine maintenance. Full height access doors shall have "hold back" latches to prevent door closure during the performance of service procedures
- 6.10.8 Access doors shall be mounted on multiple combination hinge/latch mechanisms which swing either direction 180 degrees and lifts off. Doors shall be provided for entrance to all sections housing components requiring routine maintenance. Doors shall be secured with minimum two tool-operated latches and sealed against the frame with rubber gasket material.
- 6.10.9 The system shall have non-corroding protective mesh screens covering internal fan blades, protective grates covering all floor access ports
- 6.10.10 Outdoor Air Intake:
 - 6.10.10.1 Minimum Outdoor Air connection: motorized damper, filter and time clock
- 6.10.11 Insulation: The unit shall be insulated per the following standards:
 - 6.10.11.1 All exterior cabinet sections shall be insulated with two (2) inch thick fiberglass inside the double walled cabinet
 - 6.10.11.2 Fire resistant rating to conform to NFPA Standard 90A and 90B
 - 6.10.11.3 Sound attenuation coefficient shall not be less than 1.02 at a frequency of 1,000 Hz as per ASTM Standard C423
 - 6.10.11.4 Thermal conductivity shall not exceed 0.26 Btu/hr-sqft-ft at 75 °F
- 6.10.12 Cabinet configuration shall include:
 - 6.10.12.1 A filter rack with separate access doors shall be provided for the return air and minimum outdoor air streams
 - 6.10.12.2 Unit shall be equipped with duct collars to admit the minimum outdoor air as scheduled. The outdoor air intake assembly shall have a built in air filter rack with separate access door, manual

air balancing device and motorized 2 position extruded aluminum, Insulated, silicone side-sealed damper operated by 24-hour time clock

- 6.10.12.3 Mechanical vestibule: The unit shall have the compressor, receiver, solenoid valves and the electrical panel in a separate compartment out of the processed air stream. All components shall be serviceable while the unit is in operation without disturbing the airflow
- 6.10.12.4 Electrical panel: The unit shall have a built-in electrical control panel in a separate compartment in order not to disturb the airflow within the dehumidifier during electrical servicing. All electrical components shall be mounted on a 16 gauge galvanized sub-panel

6.11 FILTERS

- 6.11.1 Wherever possible, air filters shall be standard sized, replaceable, off-the-shelf filters including:
- 6.11.2 Return Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure on a face loading rack
- 6.11.3 Supply Air: 2-inch MERV 8, 30% pleated filters with rust-free non-metallic structure on face loading rack.
- 6.11.4 Outside Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure
- 6.11.5 Outside Air: Washable, aluminum media type with aluminum U-channel frame wrapped around the perimeter of crimped layers of aluminum media. The frame is designed with drain holes to ensure removal of excess water.

6.12 COILS

- 6.12.1 Evaporator/dehumidifier coils shall be designed for maximum moisture removal capacity
- 9.12.1.1 Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion protection. Coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases
- 9.12.1.2 Coil shall have galvanized casing and end plates
- 9.12.1.3 Aluminum fin and copper tubes mechanically bonded to assure high heat transfer.
- 6.12.2 Air reheat coils shall be sized for variable heat transfer into the air with a capacity of 100% of the compressors total required heat of rejection
- 6.12.2.1 Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion protection. Coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases
- 6.12.2.2 Coil shall have galvanized casing and end plates
- 6.12.2.3 Aluminum fin and copper tube joints mechanically bonded to assure high heat transfer

6.13 DRAIN PANS

- 6.13.1 Each evaporator coil shall be provided with a positive draining, compound-sloped, baked powder paint coated aluminum drain pan with fully-welded corners to ensure zero water retention

6.14 BLOWERS AND BLOWER MOTORS

6.14.1 Supply blowers:

6.14.1.1 The complete blower assembly shall be statically and dynamically balanced on precision electronic balancers

6.14.1.2 The blower assembly shall be mounted on a 1" deflection spring isolated rack

6.14.1.3 The fan inlets shall be equipped with accidental contact protection screen

6.14.1.4 Motor(s) shall be Premium efficiency painted cast iron construction TEFC, NEMA MG1-PART 31 Inverter Duty 15:1 Constant Torque Severe Duty with a service factor 1.25. Motors shall be 6 Pole 1200 RPM synchronous speed with HOA switch with motor safeties against overloading at 60 Hz operation directly on mains. Motors shall have double lip seals on both ends with re-greasable bearings 254T frame and larger with Polyurea grease

6.15 DAMPERS

6.15.1 Internal dampers shall be made from extruded anodized aluminium with a parallel blade configuration and neoprene double-seal tips to minimize leakage. Damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant

6.15.2 The system shall be provided with normally closed outside air and exhaust air dampers equipped with spring-return actuators The dampers adjust between 0% to 100% open position.

6.15.3 The outdoor air and exhaust air dampers shall be of opposed blade configuration. Dampers shall have 0.750-inch insulated blades made from extruded anodized aluminium with neoprene double-seal tips to minimize leakage. Damper leakage shall be less than 1% of maximum flow at 4-inch water column differential. Damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant

6.16 POOL WATER HEATER

6.16.1 Potable water rated coaxial heat exchanger shall be double-wall vented construction with corrosion-resistant cupro-nickel water circuit tubing

6.16.2 Self-purging and self-draining counter flow design

6.16.3 Water circuit piping shall consist of transparent braided PVC hose

6.16.4 Terminating connections are PVC schedule 40 NPT fittings located at the cabinet wall for easy connection

6.16.5 The maximum loop operating pressure is 60 psig

6.17 COMPRESSORS

6.17.1 Hermetic, scroll action compressor, suction gas cooled, suitable for refrigerant R-410A

6.17.2 The compressor(s) shall be mounted on rubber-in-shear isolators to limit the transmission of noise and vibration

6.17.3 The compressor(s) shall be equipped with removable crankcase heater(s) for liquid migration protection

6.17.4 The compressor(s) shall be located outside the conditioned air stream in the system's service vestibule

6.17.5 Compressors shall have a 3-year warranty extension for a total of 5 years coverage

6.17.6 The compressor manufacturer must have a wholesale outlet for replacement parts in the nearest major city

6.18 REFRIGERATION CIRCUIT

6.18.1 The system shall consist of two factory sealed refrigeration circuits for dehumidification and sensible cooling. No site refrigeration work shall be required

6.18.2 Each refrigeration circuit shall have pressure transducers monitoring the refrigerant discharge (high) and suction (low) pressures. The refrigeration circuit shall be accessible for diagnostics, adjustment and servicing without the need for service manifold gauges

6.18.3 All refrigeration circuits shall have solenoid control valves, check valves, a liquid line filter-drier, liquid and moisture indicator, thermostatic expansion valve and a pump down solenoid valve

6.18.4 The system shall have an externally adjustable balanced port design mechanical thermostatic expansion valve. The valve shall have a removable power head

6.18.5 Tamper proof, hermetically sealed non-adjustable high and low pressure switches and refrigeration service valves shall be installed using Schrader type valves. Refrigeration service valves shall be located outside of the airstream

6.18.6 The receiver shall have two refrigerant level (maximum and minimum) indicating sight glasses

6.18.7 The suction line shall be fully insulated with 0.500-inch closed cell insulation

6.19 CONTROL PANEL

6.19.1 The electrical contractor shall be responsible for external power wiring and disconnect switch fusing. Power block terminals shall be provided

6.19.2 The system shall include a factory-installed non-fused disconnect

6.19.3 Shall be mounted inside the service vestibule outside of the process air stream

6.19.4 Blower motors shall be protected with thermal trip overloads

6.19.5 The system shall have a voltage monitor with phase protection

6.19.6 Available dry contacts shall include:

6.19.6.1 Alarm

6.19.6.2 Blower interlock

6.19.6.3 Stage 1 & 2 heating

6.19.6.4 Outdoor air damper control

6.19.6.5 Remote exhaust fan #1

6.19.6.6 Outdoor-air cooled equipment

6.19.6.7 System on

6.19.6.8 Auxiliary pool heater 1

6.19.6.9 Heat recovery

- 6.19.7 Terminals shall be provided to send 24-volt power to the outdoor air cooled condenser or fluid cooler fan contactor
- 6.19.8 All wiring shall be installed in accordance with UL or CSA safety electrical code regulations and shall be in accordance with the NFPA All components used in the system shall be UL or CSA listed
- 6.19.9 Wiring diagrams shall be located near the electrical panel(s) on the system. These diagrams shall provide colour-coding and wire numbering for easy troubleshooting. All wires shall be contained in a wire duct.
- 6.19.10 7.13.10 The compressor(s) shall have a time delay on start to prevent short cycling
- 6.19.11 7.13.11 Pressure transducers for measuring refrigerant discharge (high) pressure and suction (low) pressure shall be provided.
- 6.19.12 An airflow switch and a dry contact for alarm(s) shall be provided

6.20 MICROPROCESSOR CONTROL

- 6.20.1 A microprocessor controller with the following characteristics will be provided:
- 6.20.2 All set points and parameter adjustments are pre-programmed at the factory during quality control testing
- 6.20.3 The microprocessor program shall be stored on updatable FLASH memory
- 6.20.4 A minimum of 11 analogue inputs, 4 analogue outputs, 24 digital inputs and 16 digital outputs
- 6.20.5 Four serial interface ports including both RS232 and RS485 types
- 6.20.6 An Ethernet port with RJ-45 connector and LED activity indicator
- 6.20.7 A real time clock to time-stamp the system operation log and to enable a programmable 7-day occupation schedule
- 6.20.8 Two manual demand forced modes to allow the user to manually bypass the microprocessor in the event of controller failure
- 6.20.9 The local and remote operator panel(s) shall have a backlit graphic liquid crystal display with touch controls
- 6.20.10 The system shall have pressure transducers monitoring the refrigerant discharge (high) and suction (low) pressures. The refrigeration circuit shall be accessible for diagnostics, adjustment and servicing without the need of service manifold gauges.
- 6.20.11 The following status LEDs shall be on the controller:
 - 6.20.11.1 Alarm - indicates there has been a failure requiring service.
 - 6.20.11.2 Dehumidification - indicates that the system is dehumidifying the space.
 - 6.20.11.3 Cooling - indicates that the air-conditioning mode.
 - 6.20.11.4 Pool Heating - indicates that the system is heating the pool water with recycled energy.
 - 6.20.11.5 Space Heat - indicates that the space heating is operating.
 - 6.20.11.6 Maintenance - indicates whether or not maintenance is required.
 - 6.20.11.7 Manual - indicates that the system has been set to manual operation.
- 6.20.12 The following set points shall be accessible and adjustable from the operator panel:

- 6.20.12.1 Space temperature
- 6.20.12.2 Space relative humidity
- 6.20.12.3 Pool water temperature

6.20.13 The following sensors shall be unit-mounted and monitored at the operator panel. All information from these items shall be actively used in the system control and operation strategies:

- 6.20.13.1 Refrigerant high pressure
- 6.20.13.2 Refrigerant low pressure
- 6.20.13.3 Return air temperature
- 6.20.13.4 Supply air temperature
- 6.20.13.5 Return air relative humidity
- 6.20.13.6 Entering pool water temperature
- 6.20.13.7 Leaving pool water temperature
- 6.20.13.8 Evaporator leaving air temperature
- 6.20.13.9 Suction temperature
- 6.20.13.10 Discharge temperature

6.20.14 System Fault: Shall indicate via text message to the display what systems require attention or servicing. Built-in monitoring and diagnostics shall allow the user to view the following:

- 6.20.14.1 Power failure
- 6.20.14.2 Dirty air filter
- 6.20.14.3 Refrigerant high and low pressure
- 6.20.14.4 System off
- 6.20.14.5 Anti-short cycle delay

6.21 AIR HEATING

6.21.1 The packaged hot water coil module shall be sized to meet the scheduled heating capacity and have the following characteristics:

6.22 AIR CONDITIONING

6.22.1 Air-cooled air conditioning via an air-cooled refrigerant condenser.

6.22.2 The system shall be equipped with an air conditioning mode where excess compressor heat is rejected to a remote outdoor air-cooled heat exchanger

6.22.3 The system shall be provided with a dry contact rated for 24VAC/5A to operate the remote outdoor fluid cooler control

6.22.4 Each refrigeration circuit shall include refrigerant valves, a receiver with pressure relief valve set at 650 psig, a pressure control valve and a pressure differential valve, and two manual shutoff valves to isolate the outdoor fluid cooler

6.22.5 The fan(s) shall be direct driven axial fan(s) with dual speed external rotor motor(s) and innovative bionic blades in die-cast aluminum moulds

6.22.5.1 The fan assembly shall be balanced in Class G 6.3 acc DIN ISO 1940, dynamic on two levels

6.22.5.2 The fan assembly shall be suitable for ambient temperatures of -40°C to max. +70°C

6.22.5.3 Thermal contacts installed in the windings compliant with THCL 155

- 6.22.5.4 Drive motor in external rotor principle, sealed in protection class IP54 with moisture protection impregnation of the windings, topical protection
- 6.22.5.5 High corrosion resistance design with high quality and reliability

6.23 INSTALLATION

- 6.23.1 In order to be rigged through confined spaces, unit shall be shipped UNASSEMBLED and field assembled BY THE MANUFACTURER.
- 6.23.2 Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified and where manufacturer's technical representative directs otherwise.
- 6.23.3 Install unit where shown on drawings. Provide 3' feet clearance around sides and 4' feet around compressor compartment of unit for airflow and service. Provide a means for access to all sides of the unit.

6.24 START-UP, OWNER TRAINING & WARRANTY

- 6.24.1 Provide a complete parts, labor, controls system, and refrigerant warranty for five (5) years after the substantial completion on the entire unit.
- 6.24.2 All units shall be thoroughly cleaned by the installing contractor in accordance with the manufacturer's instructions, prior to being placed into service.
- 6.24.3 Start-up service shall be provided by the equipment manufacturer's authorized representative and shall include complete testing of all controls and unit operation. The agency responsible for start-up shall record the refrigeration system pressures and electrical operating data. Copies of this data are to be supplied to the owner. North America – Standard
- 6.24.4 A complete operating and maintenance manual, including wiring diagrams, start-up and operating sequence and material list shall be provided to the owner. The owner shall be provided with complete instruction of operating and maintenance procedures and all necessary cables, adapters, etc. for interface.
- 6.24.5 Manufacturer shall provide owner with 8 hours of onsite training by factory-trained service personnel. Training shall cover the operation and maintenance requirements of this unit. This training session shall be held at time of factory start up.
- 6.24.6 Manufacturer shall provide to the owner a web-based, instructional video program for use by field personnel.

PART 7 - WATER COOLED MAGNETIC BEARING CHILLER

7.1 GENERAL

7.1.1 SECTION INCLUDES

- Semi-hermetic, direct drive, multi-stage, water-cooled centrifugal chiller with single compressor.

7.1.2 SUBMITTAL

- Acceptable refrigerants on which chiller performance is based should meet EPA requirements. All proposals for chiller performance must include an AHRI approved selection for the specified refrigerants.
- Submit drawings indicating assembled dimensions, operating weight, load distribution, and required service and access clearances.

- Submit product data indicating options and specialties, electrical requirements, and wiring diagrams and connections. Indicate accessories, valves, strainers, and thermostatic valves required for the complete system.
- Submit rigging, installation, and startup procedures. Include operations and maintenance data for both the chiller and starter or variable-speed drive. Include location, size, and type of field piping connections.
- Submit performance data indicating energy input versus cooling load output from 100 to 25 percent of full load with constant entering condenser water temperature.

7.1.3 REGULATORY REQUIREMENTS

- Conform to AHRI Standard 550/590 code for rating and testing of water chillers.
- Conform to UL 1995 - Standard for Heating and Cooling Equipment, Safety Standard. In the event the unit is not UL approved, the manufacturer shall, at manufacturer expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.
- Conform to ANSI/ASME SECTION VIII Boiler and Pressure Vessel Code for construction and testing of centrifugal chillers as applicable.
- Conform to latest revision of ANSI/ASHRAE STANDARD 15 code for construction and operation of centrifugal chillers.
- Unit shall bear the AHRI Certification Label for the specific type of water chiller as applicable.

7.1.4 DELIVERY AND HANDLING

- Comply with manufacturer's installation instructions for rigging, chiller loading, local transportation requirements, unloading, storage, and final setting.
- Protect chiller and controls from physical damage. Leave factory shipping covers in place until installation. The entire unit must be shrink wrapped with an environmentally recyclable material standard. The material shall include an imbedded desiccant to minimize/eliminate internal moisture

7.1.5 WARRANTY

- Provide a standard unit parts and labor warranty for one year from startup or 18 months from factory shipment, whichever occurs first.
- A quote for a 5-year parts, labor, and refrigerant quality warranty covering all chiller components, to include starter and drive, must be supplied by the manufacturer to provide a comparative value of confidence in reliability. This quote must be of the manufacturer's warranty; third party insurance/warranty quotes are not acceptable.

7.1.6 VERIFICATION OF CAPACITY AND EFFICIENCY

- All proposals for chiller performance must include an AHRI approved selection method. Verification of date and version of computer program selection or catalog is available through AHRI.
- Performance Tolerances
 - The following allowable tolerances must be followed
 - The tolerance on allowable capacity must be as defined by AHRI 550/590 Standard.
 - The IPLV/NPLV and full load tolerances are as defined by AHRI 550/590 Standard, and the tolerances at full load and all part load test points must also be defined by AHRI Standard if applicable.

7.2 PRODUCTS

7.2.1 SUMMARY

- Description: Factory-assembled and tested water chiller complete with compressor, evaporator, condenser, controls, starter or variable speed drive, interconnecting unit piping and wiring, indicating accessories, and mounting frame. Performance shall be per the schedule on the drawings.

- The contractor shall furnish and install centrifugal water chillers as shown and scheduled in the plans and specifications. The units shall produce the specified tonnage per the scheduled data in accordance with the latest revision of AHRI 550/590. The unit shall bear the AHRI certification label as applicable.
- Base bid shall be Trane Agility chiller with approved alternate being Daikin. Job awarded on basis of specified machine. Alternate will be considered after the job is awarded.
- Unit shall be painted in accordance with the manufacturer's standard procedures and practices.

7.2.2 COMPRESSOR AND MOTOR

- The compressor shall be magnetic bearings, oil free, centrifugal with multiple stages.
- The chiller must provide backup power to the magnetic bearings with a UPS system that provides power conditioning, to completely isolate the magnetic bearing system from utility power, enabling error-free operation during surges, sags, spikes, and other power anomalies.
- The motor shall be hermetic and either suction, interstage, or liquid refrigerant cooled. Hot gas motor cooling is not acceptable. If an open motor design is used, then the manufacturer shall provide and install a complete chilled water AHU with a capacity equal to 0.9% of the chiller's tonnage to serve the chiller area, which must be completely operational and include all wiring and automatic temperature controls. The open motor chiller manufacturer must also increase chiller size by an equivalent tonnage with no increase in specified full load kW, and shall list, on the submittal, additional maintenance requirements due to alignment, refrigerant shaft seal, coupling and bearings. Additionally, if an open drive motor is provided, a motor-compressor shaft seal leakage containment system shall be provided with the following inclusions:
- The impellers shall be fully shrouded and made of a high strength aluminum alloy.

7.2.3 EVAPORATOR AND CONDENSER

- The evaporator and condenser shall be built in accordance with ANSI/ASHRAE 15 Safety Code for Mechanical Refrigeration and ASME section VIII as applicable.
- The evaporator tubes shall be internally and externally enhanced with a 0.75" outer diameter. The tubes shall be securely supported at intermediate supports and physically expanded into both ends of the tube sheets.
- The condenser tubes shall be internally and externally enhanced with a 0.75" outer diameter. The tubes shall be securely supported at intermediate supports and physically expanded into both ends of the tube sheets.
- The evaporator tubes must be removable from both ends to provide easy access for tube cleaning. The minimum evaporator tube wall thickness, root-to-root across the entire tube length shall be 0.025".
- The minimum condenser tube wall thickness, root-to-root across the entire tube length shall be 0.025".
- The evaporator water piping connections shall be Victaulic.
- The condenser water piping connections shall be Victaulic.
- Provide evaporator water box designed for 150 psig maximum waterside working pressure. Waterside shall be hydrostatically tested at 1.5 times design working pressure.
- Provide condenser water box designed for 150 psig maximum waterside working pressure. Waterside shall be hydrostatically tested at 1.5 times design working pressure.
- The evaporator water boxes shall be standard non-marine type with connections per the schedule.
- The condenser water boxes shall be standard non-marine type with connections per the schedule.
- Hinges shall be factory supplied on the evaporator shell to facilitate waterbox removal without external rigging.
- Hinges shall be on both ends of the evaporator shell
- Hinges shall be factory supplied on the condenser shell to facilitate waterbox removal without external rigging.
- Hinges shall be on both ends of the condenser shell
- Insulation will be 3/4" insulation and cover all low-temperature surfaces to include the evaporator, water boxes, suction elbow, and economizer if applicable

- Units with multi-stage compressors shall incorporate an interstage 'economizer'. All units with single stage compressors shall have the condensers circuited for liquid subcooling and controlled through the use of condenser liquid level control
- Adjustable or float type refrigerant metering devices and thermal expansion valves (TXV) shall be inspected and adjusted by the manufacturer annually for the first five years of operation to assure equivalent reliability to an electronic expansion valve (EXV) system. A written report shall be forwarded to the owner each year over the first five years to confirm completion of calibration.

7.2.4 REFRIGERANT CIRCUIT

- All units shall have 1 refrigerant circuit with a single compressor. If manifolded compressors are provided, then individual compressor warranties must be provided for each compressor motor.
- An electronically controlled expansion valve (EXV) is provided to maintain proper refrigerant flow.

7.3 CONTROLS

- The chiller shall be controlled by a unit mounted, stand-alone Direct Digital Control (DDC) system. A dedicated chiller microprocessor control panel is to be supplied with each chiller by the chiller manufacturer.
- Enclosure shall be unit mounted NEMA 250 Type 1.
- A color, touch sensitive liquid crystal display (LCD) shall be unit mounted and a minimum of 12.1" diagonal. The display shall be fully adjustable in height and viewing angle. Animated graphical representations of chiller subsystem operation shall be used to enhance the user interface.
- Display shall consist of a menu driven interface with easy touch screen navigation to organized subsystem reports for compressor, evaporator, condenser and motor information as well as associated diagnostics. The controller shall display all active diagnostics and a minimum of 20 historical diagnostics.
- Control authority must be capable of handling at least four conditions: Off, local manual at the chiller, local automatic at the chiller and automatic control through a remote source.
- Capability to connect a laptop to service utility with applicable software from manufacturer and obtain enhanced set-up and diagnostics.
- The front of the chiller control panel shall display the following in clear language, without the use of codes, look-up tables, or gauges
 - Run time
 - Number of starts
 - Current chiller operating mode
 - Chilled water set point and set point source
 - Electrical current limit set point and set point source
 - Entering and leaving evaporator water temperatures
 - Entering and leaving condenser water temperatures
 - Saturated evaporator and condenser refrigerant temperatures
 - Evaporator and condenser refrigerant pressure
 - Compressor motor current per phase
 - Compressor motor percent RLA
 - kW energy consumption and power factor
 - Compressor motor winding temperatures per phase
- The chiller control panel shall provide password protection of all setpoints
- The chiller control panel shall provide individual relay outputs to start/stop the evaporator and condenser water pumps. The condenser water pump relay output can be used to enable the cooling tower temperature controls
- The chiller control panel shall provide leaving chilled water temperature reset based upon return water temperature
- The chiller control panel shall be capable of displaying system data in I-P or SI units
- The chiller manufacturer shall include a pressure, non-mechanical based unit mounted flow switch that is of the thermal dispersion type for the condenser to verify flow through the unit

- The chiller manufacturer shall include a pressure, non-mechanical based unit mounted flow switch that is of the thermal dispersion type for the evaporator to verify flow through the unit
- Safeties - the chiller control panel shall provide the following safeties:
 - Low chilled water temperature
 - Low evaporator refrigerant temperature or pressure
 - High condenser refrigerant pressure
 - Evaporator and condenser water flow status
 - High motor winding temperatures
 - High motor current
 - AFD function faults
 - Sensor faults
 - Unit controls operation
 - The chiller control panel or starter shall incorporate advanced motor protection to safeguard the motor throughout the starting and running cycles from the adverse effects of:
 - Current phase loss
 - Current phase unbalance
 - Current phase reversal
 - Under/Over voltage
 - Motor current overload
 - Distribution fault protection with auto restart consisting of three-phase current sensing devices that monitor the status of the current
 - AFD communication-control failure
- The chiller control panel shall be capable of providing short cycling protection
- The chilled water controller of each chiller shall include variable water-flow capability to allow the chiller to respond quickly to accelerating or decelerating water, and have the following features:
 - It shall allow control of the leaving chilled water temperature to within +/- 1.0°F (0.3°C) at a water flow rate change of 10% per minute and will stay online at a water flow rate change of 30% per minute
- The chiller, upon power loss restoration, must be able to start the compressor within 65 seconds. The chiller time to fully load up to 80% shall be no longer than 4 minutes. The manufacturer shall supply documentation to support their ability to do this
- The chiller control panel shall provide a relay output that shall energize whenever the compressor is running
- The chiller control panel shall provide an alarm relay output that shall energize whenever a fault requiring manual reset is detected by the panel
- The chiller control panel shall provide a relay output that shall energize whenever the chiller is operating at maximum capacity
- The chiller control panel shall provide a head relief request relay output to indicate that the chiller is in condenser limit mode and thereby requesting condenser water temperature relief
- The chiller control panel shall provide an analog [2 - 10VDC] [4 - 20mA] output signal that shall indicate the Compressor Motor Percent RLA
- The chiller control panel shall allow for an analog input for a chilled water setpoint and an electrical current limit set point. These setpoints can be in the form of 4-20 mA or 2-10 Vdc signals from a remote source (i.e. generic building automation system)
- The chiller control panel shall provide an analog output signal that shall indicate the condenser refrigerant pressure or condenser/evaporator differential refrigerant pressure
- The chiller controller must be able to communicate directly to a building automation system using BACnet protocol (MSTP-RS 485)

7.3.1 VARIABLE SPEED DRIVE (VSD), UNIT MOUNTED

- The water chiller shall be furnished with a variable speed drive (VSD) as shown on the drawings. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested

- The VSD will be specifically designed to interface with the centrifugal water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed and compressor inlet guide vane position to maintain the chilled water setpoint while avoiding surge. If a surge is detected, VSD surge avoidance logic will make adjustments to move away from and avoid surge at similar conditions in the future
- The VSD efficiency shall be 97% or better at full speed and full load. Fundamental displacement power factor shall be a minimum of 0.96 at all loads.
- The VSD shall be solid state, microprocessor based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBTs.
- Power semi-conductor and capacitor cooling shall be from a combination of liquid cooled heatsink and air flow.
- The VSDs shall each be furnished in a metal enclosure having as minimum a short circuit withstand rating of 65,000 amps per UL 508A. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
 - Enclosure shall include a padlockable, door-mounted circuit breaker with a minimum AIC rating of 65,000 amps.
 - The entire chiller package shall be UL/CUL listed.
- The VSD panel shall be tested to ANSI/UL Standard 508A and shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as designated by OSHA.
- The drive shall meet the IEEE 519 requirements for less than 5% total demand distortion TDD with the use of an input matrix harmonic filter mounted within the drive enclosure. The losses due the filter, if applicable must be included in the chiller performance. If a remote harmonic filter is offered to meet the 5% TDD level, the performance of the chiller selection must include the filter losses. In addition, if chiller factory performance testing is selected, the remote filter must be tested with the chiller in the factory
- Input shall be nominal 460. V, three phase, 60. Hz AC power
- Line voltage tolerance +/-10% and line frequency tolerance +/-1%
- The VSD shall include the following features:
 - All control circuit voltages are physically and electrically isolated from power circuit voltage.
 - Soft start, adjustable linear acceleration, controlled ramp-down to stop.
 - Insensitivity to incoming power phase sequence.
 - Adjustable current limiting and U.L. approved electronic motor overload protection.
 - Output line-to-line short circuit protection.
 - Line-to-ground short circuit protection.
 - Protection from phase loss at AFD input.
 - Protection from output phase reversal/imbalance.
 - Protection from over/under-voltage.
 - Protection from over-temperature.
- The following VSD status indicators shall be available to the unit controller to facilitate startup and maintenance:
 - DC Bus voltage.
 - Output/load amps.
 - Fault.
- Service Conditions:
 - Operating ambient temperature of 14°F - 104°F (-10°C - 40°C).
 - Room ambient up to 95% relative humidity.
 - Elevation to 3300 feet (1000 meters). For every 300 feet (90 meters) above 3300 feet, the rated output current shall be decreased by 4% up to 9900 feet.

7.4 EXECUTION

7.4.1 INSTALLATION

- Install in accordance with manufacturer's instructions.
- Provide for connection to electrical service.
- Provide elastomeric isolation pads to reduce vibration transmission.
- On units without unit mounted starters provide for connection of electrical wiring between starter and chiller control panel, and purge unit.
- Furnish and install necessary auxiliary water piping for oil cooling units and purge condensers.
- Arrange piping for easy dismantling to permit tube cleaning.
- Provide piping from chiller relief valve to outdoors. Size as recommended by manufacturer.

7.4.2 MANUFACTURER'S FIELD SERVICES

- All Startup, functions shall be performed by a manufacturer's commercial agent to confirm (in writing) that equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty
 - Included OEM Factory Startup:
 - Magnetic Bearing, Oil Free, Centrifugal, Rotary Screw, Scroll Chillers
- Applied Chiller manufacturers shall maintain service capabilities no more than 100 miles from the jobsite.
- The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service

PART 5 – CROSSFLOW COOLING TOWERS:

8.1 GENERAL:

8.1.1 Section Includes: Open circuit, induced draft, crossflow cooling towers.

8.1.2 REFERENCE STANDARDS:

- ASHRAE 90.1-2019 – Energy Standard for Buildings Except Low-Rise Residential Buildings.
- ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2018.
- ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2018.
- ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2018b.
- ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015.
- ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014.
- CTI STD-201 OM - Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment 2017.
- CTI STD-201 RS - Performance Rating of Evaporative Heat Rejection Equipment 2017.
- CTI STD-111 - Gear Speed Reducers for Application on Industrial Water Cooling Towers; 2009. (Only for gear-driven products)
- ISO 9001 - Quality management systems -- Requirements 2015.
- NEMA MG 1 - Motors and Generators 2017.
- ASCE/SEI 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

8.1.3 SUBMITTALS

- Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections.

- Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.
- Manufacturer's Certificate: Certify that cooling tower performance, based on CTI STD-201 meets or exceeds specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.
- Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- Operation and Maintenance Data: Include start-up instructions, maintenance data, controls, and accessories.
- Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

8.1.4 QUALITY ASSURANCE

- Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 20 years of documented experience and ISO 9001 certification.
- Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum 20 years of experience and approved by manufacturer.
- Product Performance:
 - Cooling tower must have a minimum energy rating of 55.72 per ASHRAE 90.1, 189 and CA Title 24.
 - Structural and Seismic Performance: The structure will be designed, tested and certified in accordance with IBC regulations to meet a minimum unrestricted seismic design SDS = 1.41 g with an Importance Factor of 1.5 and wind load of 60 psf. Units not provided with a certificate of IBC compliance will not be an acceptable alternative.

8.1.5 DELIVERY, STORAGE, AND HANDLING

- Equipment will be factory-assembled, including a cold water basin, heat transfer section, water distribution, fan drive system, and casing panels. For shipping, disassemble into as large as practical sub-assemblies to minimize field work for re-assembly.
- Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

8.1.6 WARRANTY

- One-year warranty after start-up, or eighteen months from date of shipment, whichever occurs first. Warranty to include coverage for defects in material and workmanship.
- Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of five (5) years or seven (7) years, if motor space heater is properly wired.
- For direct drive fan system: Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of seven (7) from date of shipment. Included VFD will have 5-year warranty.

8.2 PRODUCTS

8.2.1 MANUFACTURERS

- Open Circuit, Induced Draft, Crossflow Cooling Towers:
 - Basis of Design: Baltimore Aircoil Company; Series 1500
- Acceptable manufacturers: Marley and EVAPCO.

8.2.2 MANUFACTURED UNITS

- Provide units suited for outdoor use, factory-assembled, induced draft with vertical discharge of air, and fan assemblies built into casing.

8.2.3 COMPONENTS

- Cold Water Basin:
 - Type 304 welded stainless steel panels and structural members. A removable anti-vortexing hood will be provided to prevent air entrainment. Large area lift out strainers will be provided with perforated openings sized smaller than the water distribution system nozzles. Sloped with depressed section with drain/clean-out connection. Basins with bolted seams or constructed of 301 stainless steel are not acceptable.
- Water Distribution System
 - The hot water distribution basins will be gravity-fed and accessible from the outside of the unit for service or inspection while unit is in operation. Included weir dams will accommodate a flow range of 50% to 100% of the design flow rate. Lift-off distribution covers will be constructed of steel and designed to withstand a 50 psf (244 kg/m²) live load or 200 pound (90.7 kg) concentrated load.
- Casing Panels and Framework:
 - Casing panels will be constructed of corrosion and UV-resistant fiberglass-reinforced polyester (FRP) to minimize maintenance requirements and prolong equipment life.
- Air Inlet Louvers
 Combined Inlet Shields (PVC)
 - PVC Inlet Shields: Louver sections will be individually removable sections. The combined inlet shields will be UV resistant PVC, installed on the air inlet face to minimize air resistance, prevent water splash out, and minimize sunlight exposure to reduce the potential for algae growth in the cold water basin.
- Fans: Multi blade, axial type. Fans must factory test-mounted, balanced, and aligned to ensure reliable operation and ease of maintenance. Fan type will be selected to meet sound ratings published on equipment schedule.
 - Single speed (1800 rpm) premium efficiency, cooling tower duty motor mounted on adjustable steel base. Fan motors will be inverter duty type designed per NEMA Standard MG1, Section IV Part 31. Motors will include an internal space heater that can be wired to remove condensation when motor is not in use.
 - Belt Drive: Designed for minimum 150 percent motor nameplate power. Fan and motor sheave(s) will be fabricated from corrosion-resistant materials to minimize maintenance and ensure maximum drive and powerband operating life. Bearings must have a minimum L-10 life of 80,000 hours per ABMA STD 11. Belt tension must be easily adjusted in the field.
 - Ultra low sound fan package

Extended Grease Fittings: Extended grease lines are supplied that reach from the bearing to fittings on the exterior casing near the access doors. This facilitates easy periodic bearing maintenance without entering the tower.

- Fan Guard:
 - Welded steel rod and wire guard, hot dipped galvanized after fabrication. Installed over fan discharge.
- Motor Removal Davit: The unit will be equipped with a mechanical equipment removal davit. The motor will lower from the mechanical equipment supports down to grade. Davit will attach to the unit without the need for tools. If tools are required for davit installation or removal, provide (1) davit for each motor provided.
- Gravity-fed Distribution: Hot water basins will have removable covers for inspection while unit is in operation, weir dams and metering nozzles for at least 50 percent turndown capability. Gravity flow nozzles will be snap-in type for easy removal. Pressurized nozzles are not acceptable.
- Balancing Valves: Heavy-duty butterfly valves will be provided at the hot water inlet connections. These valves will include cast iron bodies, elastomer seat and steel operating lever.
- Fill:

- The fill and integral drift eliminators will be formed from self-extinguishing (per ASTM-568) polyvinyl chloride (PVC) having a flame spread rating of 5 per ASTM E84 and will be impervious to rot, decay, fungus and biological attack. The fill is suitable for entering water temperatures up to and including 130°F (54.4°C). The fill must be manufactured, tested and rated by the cooling tower manufacturer and are elevated above the cold water basin floor to facilitate cleaning. If louvers are attached to fill, a spare set of fill sheets are required in case of icing and scaling damage.
- Drift Eliminators: Three-pass design made of PVC material. Primary eliminators will be integrated into the fill media.
- Basin Water Level Control:
 - Corrosion resistant PVC make-up valve with plastic float for easy adjustment of operating water level.

8.2.4 ACCESSORIES

- Vibration Switch
 - Provide a mechanical local reset vibration switch. The mechanical vibration cutout switch will be guaranteed to trip at a point so as not to cause damage to the cooling tower. To ensure this, the trip point will be set in a frequency range of 0 to 3,600 RPM and a trip point of 0.2 to 2.0 g's.
- Access Packages: See submittal documents for access package requirements. Platforms and ladders must ship assembled from cooling tower manufacturer.
- Plenum Access: Two hinged access doors must be provided for access into the plenum section. Include an internal walkway for inspection and maintenance. All working surfaces will be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.7 kg) concentrated load. Other components of the cooling tower, i.e. basin and fill/drift eliminators, will not be considered an internal working surface. Cooling tower designs that utilize these surfaces as working platforms will not be acceptable. Cooling tower manufacturers that promote these surfaces to be used as a working platform will provide a two-year extended warranty to the Owner to repair any damage to these surfaces caused during routine maintenance.
- Louver Face External Platforms: Easy access to the hot water basins for inspection of spray water distribution, even during tower operation, will be provided by external platforms at the louver face. Fan deck ladders and handrails, which add to the overall height of the tower, are not acceptable. Platforms and ladders must ship assembled from cooling tower manufacturer.
- Available on Double Height Models, Internal Service Platform: An internal platform will be provided in the plenum section to provide for inspection and maintenance of internal components and drive system. All working surfaces will be able to withstand 50 psf (244 kg/m²) live load or 200 pound (90.7 kg) concentrated load. Platforms and ladders must ship assembled from cooling tower manufacturer.
- Access Door Platform: An external galvanized steel access platform at the access door of the unit(s) provides access to the spray distribution system or internal plenum. An aluminum ladder and 1-1/4 inch (32 mm) galvanized steel pipe safety railing is included with the platform. This option meets pertinent OSHA standards. Platforms and ladders must ship assembled from cooling tower manufacturer.
- Safety Gates: All handrail access openings will be provided with a self-closing safety gate for increased safety.

8.3 EXECUTION

8.3.1 INSTALLATION

- Install in accordance with manufacturer's instructions.
- Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one eight-hour day per tower.
- Install tower on structural steel beams as instructed by manufacturer.

- Connect condenser water piping to tower. Pitch condenser water supply to tower and condenser water suction away from tower.
- Connect make-up water piping to tower. Pitch to tower.
- Connect overflow and drain to acceptable discharge point as required by jurisdiction.

8.3.2 FIELD QUALITY CONTROL

- See Section Quality Requirements, for additional requirements.
- Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

8.3.3 SYSTEM START-UP

- Start-up tower in presence of and instruct Owner's operating personnel.

PART 9 – ENERGY RECOVERY UNITS:

9.1 ACCEPTABLE MANUFACTURERS: Diakin, York, Carrier, Trane, AAON.

9.2 Provide factory built and factory tested air handling units of sizes, capacities and configurations as scheduled and as specified herein. Unit layout shall be dual path, providing one path for outside air with all components arranged in series as specified and providing one path for exhaust air with all components arranged in series as specified.

9.3 Provide factory installed external support kit on the base of the unit. Unit mounting devices not constructed of galvanized steel shall be chemically cleaned, coated with rust-inhibiting primer and finished with rust inhibiting enamel.

9.4 CASINGS:

9.4.1 Unit shall be double wall foam injected constructed in all sections. Foil facing on insulation shall not be acceptable as a substitute for double wall construction. Insulate all sections with 2" thick foam injected insulation, 1 ½ lb per cubic foot density. All panels shall be solid on the interior and exterior. Insulation shall comply with NFPA 90A. Fiberglass insulation shall not be acceptable.

9.4.2 Unit shall be constructed of a complete structural frame with removable panels. Removal of all exterior panels shall not affect the structural integrity of the unit. Installing Contractor shall be responsible to provide connection flanges and all other framework that is needed on unit to ensure that removals of unit's panels shall not affect structural integrity.

9.4.3 All exterior panels and structural frames shall be constructed of G90-U galvanized steel. Casings not constructed of G90-U galvanized steel, casings with welds on interior and exterior surfaces that have burned through to exterior surfaces shall be chemically cleaned, coated with rust inhibiting primer and finished with rust inhibiting enamel.

9.4.4 Construct casing sections located upstream of the supply fan for operation at 4 inches water gauge negative static pressure and casing sections located downstream of the supply fan for operation at 6 inches water gauge positive static pressure.

9.4.5 All joints between exterior panels and structural frames shall have seals and gaskets with closed-cell foam gasketing for air seal and acoustical break.

9.4.6 As required for routine service access, unit shall be supplied with full height, galvanized, double wall, hinged, removable access doors. Access door shall have a full perimeter automotive type gasket to prevent

air leakage, and Ventlock style handle that can be opened from unit interior. Doors shall open against system pressure. If access doors open against unit operating pressure, provide safety latches that allow access doors to partially open after the first handle movement and fully open after second handle movement. All handles shall operate easily without special tools.

9.5 FAN SECTIONS:

- 9.5.1 Provide fan sections with fan type as specified on drawings designed and suitable for class or service indicated. Fan sections shall have full height, double wall hinged, removable access doors on drive side for inspection and maintenance of internal components. Fan sections with plug fans shall have galvanized expanded metal access door guards to prevent unauthorized entry into fan sections when access doors are opened.
- 9.5.2 Mount fans on isolation bases. Internally mount motors on same isolation bases and internally isolate fans and motors with a minimum of 2-inch spring isolators. Provide adjustable motor base, adjusted with mounting bolts, to provide variation in center distance. Provide locking nuts, or similar devices, to secure base in proper position. Install flexible canvas ducts between fan and casings to ensure complete isolation. Flexible canvas ducts shall comply with NFPA 90A. Fan and motor assembly shall be weighed at the manufacturer's factory for isolator selection. Vibration shall be measured at each fan shaft bearing in horizontal, vertical and axial directions. All fans shall have pillow block bearings with minimum L-50 200,000 hour rating. Provide grease lubricated fan bearings with externally accessible fittings for lubrication. Extend both grease lubrication fittings to drive side of unit with plastic tubes and zerk fittings rigidly attached to drive side bearing support.
- 9.5.3 Motors shall be 3 phase ODP with NEMA frame and 1.15 service factor. Motor base shall be adjustable. Motor brake horsepower shall not exceed scheduled values. Fan brake horsepower shall not exceed 85% of motor horsepower. All motors shall comply with EPACT efficiency requirements. Refer to Specification Section – ELECTRIC MOTORS, ETC. for more requirements. Fan sections controlled by variable frequency drives and shall be factory installed. Refer to Specification Section - CONTROLS for all VFD specification requirements.
- 9.6 DAMPERS: Provide internally mounted ultra low leak outside air dampers as specified on drawings. Dampers shall be double-skin airfoil design. Construct damper blades and damper frames of galvanized steel. Blades shall rotate on stainless steel sleeve bearings. Leakage rate shall not exceed 5 CFM/square foot at one inch water gauge and 9 CFM/square foot at 4 inches water gauge.
- 9.7 ENERGY RECOVERY SECTION: Manufacturers: Thyvent, Fresh Air Solutions, Semco, Novell-aire, XETEX. Energy Recovery Modules shall be installed in casing structure to match the OA unit construction throughout. A removable panel shall be provided to access the energy recovery cassette for service and inspection. Energy recovery wheel shall be mounted in a slide out cassette. A wiring box shall be provided for permanent connection of a power source. The Energy Recovery Cassette shall contain a 4 Angstrom total energy recovery wheel for sensible and latent energy recovery. A wheel drive motor having permanently sealed ball bearings shall be provided with plug-in connection to a receptacle mounted within the cabinet. Provide the ERW with a factory installed starter/disconnect. The total enthalpy wheel shall be supplied by the module manufacturer and be constructed of a light weight polymer material with a permanently bonded silica gel desiccant coating. Eight energy transfer sections shall be removable from the energy recovery wheel without the use of special tools. The units shall not require a condensation pan. Energy transfer ratings must be ARI Certified to Standard 1060 and bear the ARI certification symbol for ARI Air-to-Air Energy Recovery Ventilation Equipment Certification Program based on ARI 1060.
- 9.8 FILTERS: Filters shall be 2" thick, 30% efficient Merv 8, pleated and disposable. The filter pressure drop shall be 0.28" at 500 fpm face velocity. Each filter shall consist of a non-woven cotton and synthetic fabric media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2. Provide filter boxes with either hinged access doors at each end. Provide racks to receive filters in

either flat or angle type pattern. Provide air filters to fit in filter box of the type scheduled on the drawings. Sizes and quantities shall be per the manufacturer's recommendations. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for Temporary Use of Equipment Requirements and filter quantities.

- 9.8.1 Disposable Filter Media: Filter Media shall be 2" thick fiberglass Air Filter Media Pads with an initial maximum pressure drop of 0.20"wg @ 500 fpm.
- 9.8.2 Retainer Frame and Backing Wire Frame: Provide for each filter to support the disposable filter media. Products shall be factory assembled. Retainer Frame shall be 10 gauge minimum and shall be provided with additional angled support prongs to prevent sagging filter pad. Frame shall be 18 gauge minimum and shall have flush mitered corners. Frames shall also be provided with 16 gauge galvanized 1x1 welded wire support backing.
- 9.9 EQUIPMENT START-UP: Prior to utilization of equipment, start-up service shall be performed by factory authorized representative. Utilize startup sheets included in the Specification Section GENERAL PROVISIONS - MECHANICAL. Refer to Specification Section GENERAL PROVISIONS – MECHANICAL for additional requirements.
- 9.10 Provide eight (8) hours of onsite training for this system. All training to occur after building completion. System shall function properly and O&M staff shall be able to operate the system prior to turnover.

END OF SECTION.

DIVISION 23 - HVAC

SECTION 230800 - HVAC COMMISSIONING

PART 1 - GENERAL

1.1 RELATED WORK

1.1.1 Division 22 – Plumbing

1.1.2 Division 26 – Electrical

1.2 REFERENCES

1.2.1 Drawings and general provisions of contract, including general and supplementary conditions, general mechanical provisions and Division-1 Specification sections, apply to work of this section.

1.2.2 ASHRAE Guideline 1-1996

1.2.3 ASHRAE Guideline 0-2005

1.2.4 ACG Commissioning Guideline – 2005

1.3 DESCRIPTION OF WORK

1.3.1 The purpose of the commissioning process is to provide the owner/operator of the facility with a high level of assurance that the mechanical systems have been installed in the prescribed manner, and operate within the performance guidelines set in the Basis of Design Documents (BOD). The CA shall provide the owner with an unbiased, objective view of the system's installation, operation, and performance. This process is not intended to take away or reduce the responsibility of the design team or installing contractors to provide a finished product. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems for beneficial use by the owner. The CA will be a member of the construction team, administrating and coordinating commissioning activities with the design team, construction manager, subcontractors, manufacturers and equipment suppliers.

1.3.2 The independent commissioning agent (CA) contracted directly with the owner for this project. This specification has been included for reference only to define contractors' responsibilities. Each contractor should review this procedure and include adequate time in their proposal.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 ROLES OF THE COMMISSIONING AGENCY

3.1.1 The primary point of responsibility is to inform the construction manager, the owner and design team on the status, integration, and performance of HVAC systems within the facility.

3.1.2 The CA shall function as a catalyst and initiator to disseminate information and assist the design and construction teams in implementing completion of the construction process. This shall include system verification, functional performance testing, and conformance with the intended design of each system.

Services include documenting construction observations, verification and functional performance testing, and documenting proper distribution of performance and operating information to the owner's O&M staff.

- 3.1.3 Assist the responsible parties to maintain a high quality level of installation by meeting or exceeding prevailing standards and specifications.
- 3.1.4 The CA shall observe and coordinate testing as required to assure system performance meets the design intent.
- 3.1.5 The CA shall document the results of the performance testing directly and/or assure that the appropriate technicians document testing. The CA shall approve standard forms to be used by all parties for consistency of approach and type of information to be recorded.
- 3.1.6 The CA shall provide technical expertise to oversee and verify the correction of deficiencies found during the commissioning process.
- 3.1.7 The CA is to remain an independent party with specific knowledge of the project. The CA shall investigate the scope and extent of the problem and facilitate communication to determine responsibilities by delineating specifications. The CA shall monitor resolution for conformance with design intent and prevailing industry standards.
- 3.1.8 The CA shall document the date of acceptance as determined by the construction manager, owner and design team. System Verification Checklists and Functional Performance Test results may be used in determining the start of the warranty period for HVAC systems and subsystems.
- 3.1.9 The CA will review operating and maintenance materials for HVAC systems.
- 3.1.10 The CA will review phasing plans as provided by the CM relating to temporary use of HVAC equipment, O&M considerations, warranty issues, impact of construction sequencing on occupied areas, and interruption of services from the existing equipment.

3.2 SYSTEMS INCLUDED IN THE COMMISSIONING PROCESS

- Pumps
- Heat Exchanger
- Medical Air Compressor
- Vacuum Pump
- Exhaust Fans
- DDC Control System
- Electrical Room AC Units
- Fan Coil Units

3.3 HVAC COMMISSIONING PLAN

- 3.3.1 Commissioning Team: The Commissioning Team (CT) shall consist of key parties involved in design, construction and testing of this facility. It is necessary for each agency to appoint team members that will have long-term commitments to this project. Switching team members during the project will reduce the ability of the CT to provide continuity and acceptable results to the building owner. Team members must maintain an ongoing supervisory position on this project. One team member shall be provided by each of the parties listed below:

- Program Manager (PrM)
- Facilities Management Division (FMD)
- Commissioning Agent (CA)

Design Team (DT)
General Contractor (GC)
Mechanical Contractor (MC)
Controls Contractor (CC)
Test and Balance Contractor (TABC)
Electrical Contractor (EC)

3.3.2 Basis of Design Document

- The Basis of Design Document (BOD) represents a composite of design drawings, project specifications, submittals, change orders and industry standards that describe the systems of this facility. References to design intent will be taken from these contract documents. The BOD is an evolving manuscript maintained by the design professional to track and incorporate design alterations that occur throughout the construction process. Any industry standards used for this project will be specifically noted when referenced.
- The CA will review the BOD documents for adequate commissioning provisions, functional performance, optimization of performance, accessibility, TAB provisions, and O&M considerations.

3.3.3 Commissioning Meetings: Commissioning meetings will be held in conjunction with progress meetings as necessary. The CA will be on site for the CX meetings. Commissioning meetings will be used to address any problems that alter the design intent or affect the commissioning process. These meetings provide an open forum for exchange of ideas between contractors, vendors, designers, users and owners.

3.3.4 Resolution Tracking Forms (RTF)

- The use of Resolution Tracking Forms is a method employed by the CA to monitor and record problems, their causes, and solutions. The use of these lists promotes communication between the installing contractors, design team, commissioning agent, and owner, in order to expedite their resolution in a timely manner.
- The CA will regularly submit RTF's to the CT in order to document and resolve deficiencies as quickly as possible. The frequency of RTF submission will be adjusted as project conditions dictate.

3.3.5 System Verification Checklists (SVC) / Manufacturers' Checklists

- The MC will provide SVC's based on manufacturers start-up procedures. These tests should be provided for all systems and subsystems. See *SYSTEMS INCLUDED IN THE COMMISSIONING PROCESS*. Draft copies will be submitted to the CT for review and comment prior to placement on the job site. A master copy of the SVC's will be bound in a three-ring binder and placed on the job site for use by the installing contractors. No system will be started until the appropriate SVC's have been completed.
- The CA will review the SVC for each piece of equipment prior to start-up. Equipment will be released for start-up only after these checklists have been completed by the installing contractor and reviewed by the CA.
- The equipment manufacturers' checklists must also be reviewed by the CA prior to start-up. These lists must be completed by the installing contractor, and reviewed by the CA before start-up can commence.

3.3.6 Start-Up

- Start-up of major HVAC systems will be witnessed the CA. The appropriate contractors and/or manufacturer's representative will be required on site to perform start-up. No system will be started until the appropriate SVC's have been completed. No system will be started until the Manufacturer's checklists have been completed. Start-up will be performed according to the Manufacturer's recommended procedures. The CA will visit the site to review completeness of installation in conjunction with progress meetings prior to starting HVAC equipment.
- CT members involved in installation, fabrication, manufacture, control, or design of equipment are required to be present at the time of start-up. A factory-authorized technician will be on site to start

equipment when required by the specifications. This will minimize delays in bringing equipment on line and expedite acceptable functional performance in accordance with the BoD.

- 3.3.7 Controls Monitoring: Close monitoring of the Control Contractor's progress will promote efficient coordination of the TAB work. The CC will be expected to submit point-to-point checklists verifying that his work has been completed and all systems are ready for TAB work and Functional Performance Testing. Programming and graphics will be surveyed by the CA for completeness and conformance with the BoD and the owner's scheduling requirements.
- 3.3.8 TAB Monitoring
- The preliminary TAB report set-up will be reviewed prior to HVAC equipment start-up, in order to assure that the final TAB report format and content is acceptable.
 - TAB work will be monitored so that any problems that prevent or hinder proper air and water balance can be addressed and corrected with minimal delays. By addressing these problems as quickly as possible, we can assure that functional performance testing and owner training will take place on schedule.
 - A pencil copy of the TAB report will be reviewed prior to submission of the final TAB report. A written review will be submitted to the TAB contractor and to the DT for their comments. A TAB report approved by the DT will be required before Functional Performance Testing can be carried out. The CA will visit the site during the TAB process in order to assist TABC and CC in the effective completion of their scope of work.
- 3.3.9 Functional Performance Tests (FPT)
- The CA will write FPT's based on the respective sequence of operations. These tests will be created for systems and subsystems. See *SYSTEMS INCLUDED IN THE COMMISSIONING PROCESS* above.
 - Each major system will be tested. A random sample of each subsystem will be tested. This will be coordinated and witnessed by the CA and the owner's maintenance staff. Witnessing the FPT's will serve as a compliment to the O&M Training. No FPT's will be performed until the system and related subsystems have been started, the TAB report has been submitted and reviewed, and the completion of the control system has been documented through point-to-point checklists and other documentation.
 - The Functional Performance Tests shall include HVAC and related equipment.
 - Units will be tested in designed operating modes. Proper operation will be verified at automatic control, and other modes, if necessary, to achieve BOD conformance.
 - Hot water system will be tested.
 - EF's will be tested for conformance to BoD.
 - Vacuum Pump
 - Medical Air Compressor
 - DDC control systems will be tested as necessary.
 - HVAC systems will be tested to assure that the building as an integrated system operates properly.
 - Trend verification of systems and subsystems shall be completed prior to start of functional performance testing. CA will provide trend format to CC and discuss trend requirements in CX meetings throughout the construction phase of project.
 - Deferred Testing
 - If tests cannot be completed because of a deficiency outside the scope of the responsible contractor, the deficiencies shall be documented and reported to the Owner. Deficiencies shall be resolved and corrected by the appropriate parties and test rescheduled.
 - Off-season mode testing will be implemented as necessary to assure conformance with the BoD. Installing contractors will be expected to participate as required by the project specifications.
 - Rescheduled Functional Performance Test
 - During Functional Performance Testing period, it is assumed that the contractors will be complete with all checklists when the commissioning agents travel to site. If the work is not ready for

commissioning when the commissioning personnel are on site, their time will be billed to the contractor as an additional fee.

- If the contractor has deficiencies that cannot be corrected at the time of the test, that part of the sequence will be retested at a later date. If the deficiency does not pass during the retest, the contractor will be billed for the commissioning personnel's return trip.
- Building Turn-Over / Owner Orientation / User Training
 - The CA will oversee contractors prepare, coordinate and review O&M manuals, working closely with each contractor to achieve specificity and completeness.
 - The CA will review as-built drawings, working closely with each contractor to achieve specificity and completeness.
 - Owner training will be coordinated with the assistance of the CA. The training will be provided by the installing contractor, or manufacturer's representative, and witnessed by the CA. This training should include both classroom training and hands-on operational training. The owner may choose to videotape this training for future use. The CA will visit the site during the Turn-Over and Training period to assure that any on-going HVAC related problems are being addressed and corrected in a timely and efficient manner.
 - The CA will assist in the coordination of off-season testing, calibrating, and servicing as specified in the contract documents.

3.4 RESPONSIBILITIES OF TEAM MEMBERS

3.4.1 General Contractor (GC)

- Include commissioning requirements in the mechanical, electrical, and controls contracts, as well as other subcontracts, to assure full cooperation of all parties in the HVAC commissioning process.
- Assure acceptable representation, with the means and authority to prepare and coordinate execution of the mechanical commissioning program as described in the contract documents.
- Assure that the CA shall receive a copy of all construction documents, addenda, change orders and appropriate approved submittals and shop drawings for review and use in development of the commissioning plan.
- Coordinate inclusion of commissioning activities in the construction schedule.
- Facilitate resolution of deficiencies identified by observation or performance testing.
- Assist the CA in monitoring the duct leakage testing.

3.4.2 Mechanical Contractor (MC)

- Each contractor in this division shall include in their quote the cost of participating in the commissioning process.
- Include requirements for submittal data (including partial load data), O&M data, and training in each purchase order or sub-contract.
- Assure cooperation and participation of specialty sub-contractors such as sheet metal, piping, refrigeration, water treatment, temperature controls, and TAB in commissioning activities.
- Assure participation of major equipment manufacturers in appropriate startup, training, and testing activities.
- Attend commissioning meetings scheduled by the CA.
- Assist the CA in system verification and performance testing.
- Prepare preliminary schedule for HVAC system inspections, O & M manual submission, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, system verification, performance testing, and system completion for use by the CA. Update schedule as appropriate throughout the construction period.
- Complete System Verification Checklists and manufacturer's pre-start checklists prior to scheduling startup of HVAC equipment.
- Monitor and respond to Resolution Tracking Forms distributed by the CA in order to expedite corrective actions necessary to achieve design intent.
- Notify the CA a minimum of two weeks in advance of scheduled system start-up.

- Update drawings to as-built condition and review with the CA throughout the construction process.
- Schedule vendor and subcontractor provided training sessions as required by project specifications.
- Provide written notification that the following work has been completed in accordance with the project specifications, and that the equipment, systems and sub-systems are operating in accordance with design intent.
 - HVAC equipment including fans, AC units, fan coil units, ductwork, dampers, terminal devices, etc.
 - Fire detection and smoke detection devices furnished under other divisions as they affect the operation of the HVAC systems.
 - That BAS is functioning in accordance with design intent.
- Participate in the Functional Performance Tests.
- Participate in the off-season mode testing.
- Participate in O&M Training as required by project specifications.
- Provide a complete set of as-built drawings and O & M manuals for review. The CA shall review the as-built drawings and O&M manuals concurrently with the design team.

3.4.3 Test and Balance Contractor (TAB)

- Include cost for commissioning requirements (participation) in the contract price.
- Attend commissioning meetings scheduled by the CA.
- Submit the TAB procedures and preliminary TAB report to the CA for review at least two weeks prior to beginning TAB work.
- Notify the CA a minimum of two weeks in advance of scheduled TAB work.
- Provide partial, preliminary TAB Reports by phase, by building section, by system, or as required by the CA.
- Assist the CA in system verification and performance testing.
- Monitor and respond to Resolution Tracking Forms distributed by the CA in order to expedite corrective actions necessary to achieve design intent.
- Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the CA for verification or diagnostic purposes.
- Participate in the Functional Performance Tests as required to achieve design intent.
- Provide sound and vibration where required to assist in diagnosis of areas exhibiting unacceptable levels of noise or vibration.
- Participate in the off-season mode testing as required to achieve design intent.
- Participate in O&M Training as required by project specifications.

3.4.4 Temperature Control Contractor (TCC)

- Include cost for commissioning requirements in the contract price.
- Review control sequence and component selection for conformance with design intent.
 - Attend a submittal review meeting with the CA and Engineer to ensure clear understanding of scope of work and expectations.
 - Verify that specified safeties and interlocks have been selected.
 - Verify proper selection of control valves and actuators based on design parameters.
 - Verify proper selection of control dampers and actuators based on design parameters.
 - Verify that sensor selection conforms to design intent.
- Attend commissioning meetings scheduled by the CA.
- Provide the following submittals to the CA:
 - Hardware and software submittals.
 - Control panel construction shop drawings.
 - Narrative description of control sequences for each HVAC system and subsystem.
 - Schematics showing all control points, sensor locations, point names, actuators, controllers and where necessary, points of access.

- A list of all control points, including analog inputs, analog outputs, digital inputs and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.
- A complete listing of all software routines employed in operating the control system. Also provide a program narrative that describes the logic flow of the software and the functions of each routine and sub-routine. The narrative should also explain individual math or logic operations that are not clear from reading the software listing.
- Hardware operation and maintenance manuals.
- Application software and project applications code manuals.
- Panel and equipment insert documents.
- Assist CA with remote monitoring capabilities. Supply any software and/or hardware needed.
- Verify that specified interfaces provided by others are compatible with BAS hardware and software.
- Coordinate installation and programming of BAS with construction and commissioning schedules.
- Complete System Verification Checklists and manufacturer's pre-start checklists prior to scheduling startup of HVAC equipment.
- Provide control system technician to assist during equipment startup.
- Monitor and respond to Resolution Tracking Forms distributed by the CA in order to expedite corrective actions necessary to achieve design intent.
- Participate in the Functional Performance Tests as required by the project specifications.
- Provide a control system technician to assist during verification and performance testing.
- Provide system modifications to achieve system operation as defined by the design intent.
- Provide support and coordination for TAB contractor. Provide all devices, such as portable operator terminals and all software for the TAB to use in completing TAB procedures.
- Provide written notification that the TCC scope of work has been completed in accordance with the project specifications, and that the equipment, systems and sub-systems are operating in accordance with design intent, and that BAS is functioning in accordance with design intent.
- Participate in the Functional Performance Tests as required to achieve design intent.
- Participate in the off-season mode testing as required to achieve design intent.
- Participate in O&M Training as required by project specifications. Include training on hardware operations and programming

END OF SECTION

DIVISION 23 - HVAC

SECTION 231100 - REGISTERS, GRILLES, DIFFUSERS & LOUVERS

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

PART 2 – REGISTERS, GRILLES AND DIFFUSERS:

- 2.1 Acceptable R, G & D manufacturers are Krueger, Price, Anemostat, Nailor Industries, Titus and Tuttle & Bailey. Shop drawings shall identify and list all characteristics of each device exactly as scheduled herein. Finishes for specified devices shall be selected by the Architect. Factory color samples shall be submitted with shop drawings. Devices shall be white unless noted otherwise. Aluminized steel devices are not acceptable. Steel devices are not acceptable unless specifically noted otherwise.
- 2.2 Include with the shop drawings a room-by-room schedule indicating devices installed. Also note ceiling types and installations.
- 2.3 Refer to drawings for schedule.

PART 3 – LOUVERS:

- 3.1 Acceptable louver manufacturers are Ruskin, Greenheck, United Enertech, Arrow. Shop drawings shall identify and list all characteristics of each device exactly as scheduled herein. Finishes shall be selected by the Architect. Factory color samples shall be submitted with shop drawings.
- 3.2 Refer to drawings for schedule.

END OF SECTION.

DIVISION 23 - HVAC

SECTION 231200 - SHEET METAL

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 This branch of the work includes all materials, labor and accessories for the fabrication and installation of all sheet metal work as shown on the drawings and/or as specified herein. Where construction methods for various items are not indicated on the drawings or specified herein, all such work shall be fabricated and installed in accordance with the recommended methods outlined in the latest edition of SMACNA's Duct Manual and Sheet Metal Construction for Low Velocity Ventilating and Air Conditioning Systems. All equipment furnished by manufacturers shall be installed in strict accord with their recommended methods.
- 1.3 Ductwork shall be constructed and installed per the latest edition of the International Mechanical Code.
- 1.4 Ductwork shall be kept clean at all times. Ductwork stored on the job site shall be placed a minimum of 4” above the floor and shall be completely covered in plastic. Installed ductwork shall be protected with plastic. Do not install the ductwork if the building is not “dried-in”. If this is required, the entire lengths of duct shall be covered in plastic to protect. The Owner/Engineer shall periodically inspect that these procedures are followed. If deemed unacceptable, the Contractor shall be required to clean the duct system utilizing a NADCA certified Contractor.
- 1.5 Prior to purchase and fabrication of ductwork (shop fabricated or manufactured), the Contractor shall coordinate installations with new and existing conditions. Notify the Engineer if there are any discrepancies for resolution.
- 1.6 For healthcare projects, provide a SMACNA duct cleanliness level “C” per the latest SMACNA standards.

PART 2 – LOW VELOCITY DUCTWORK:

- 2.1 Ductwork, plenums and other appurtenances shall be constructed of the materials of the minimum weights or gauges as required by the latest SMACNA 2” W.G. Standard or below table. When gauge thickness differs, the heavier gauge shall be selected. The below table shall serve as a minimum.

| <u>Round Diameter</u> | <u>Duct Gauge</u> | <u>Rectangular Width</u> | <u>Duct Gauge</u> |
|-----------------------|-------------------|--------------------------|-------------------|
| 3-12 Inches | 26 Ga. | 3-12 inches | 26 Ga. |
| 12-18 Inches | 24 Ga. | 13-30 inches | 24 Ga. |
| 19-28 Inches | 22 Ga. | 31-54 inches | 22 Ga. |
| 29-36 Inches | 20 Ga. | 55-84 inches | 20 Ga. |
| 37-52 Inches | 18 Ga. | 85 inches and up | 18 Ga. |

- 2.2 All ductwork connections, fittings, joints, etc., including longitudinal and transverse joints, seams and connections shall be sealed. Seal with high velocity, smooth-textured, water based duct sealant. Sealant shall be UL 181B-M listed, UL 723 classified, NFPA 90A & 90B compliant, permanently flexible, non-flammable, and rated to 15”wg. Apply per manufacturer's recommendations. Contractors shall ensure no exposed sharp edges or burrs on ductwork.
- 2.3 Duct dimensions indicated are required inside clear dimensions. Plan duct layouts for adequate insulation and fitting clearance.

- 2.4 All angular turns shall be made with the radius of the center line of the duct equivalent to 1.5 times the width of the duct.
- 2.5 Cross-break all ducts where either cross sectional dimension is 18" or larger.
- 2.6 Ducts shall be hung by angles, rods, 18 ga. minimum straps, trapezes, etc., in accordance with SMACNA's recommended practices. Duct supports shall not exceed 12 ft intervals. There shall be no less than one set of hangers for each section of ductwork. Where ductwork contains filter sections, coils, fans or other equipment or items, such equipment or items shall be hung independently of ductwork with rods or angles. Do not suspend ducts from purlins or other weak structural members where no additional weight may be applied. If in doubt, consult the Structural Engineer.
- 2.7 Double turning vanes shall be installed in square turns and/or where indicated.
- 2.8 Provide a "high efficiency" type take-off with round damper (Flexmaster STOD-B03 or approved equal) for all round duct branches from a rectangular main to a GRD. Refer to the detail on the drawings for all installation requirements.
- 2.9 Air volume dampers shall be installed in each duct branch takeoffs and/or where indicated, whichever is more stringent. All such dampers shall be accessible without damage to finishes or insulation and shall be provided where required for proper system balance.
- 2.10 Unless otherwise dimensioned on the drawings, all diffusers, registers and grilles shall be located aesthetically and symmetrically with respect to lighting, ceiling patterns, doors, masonry bond, etc. Locate all supply, return and exhaust diffusers and grilles in the locations shown on the architectural reflected ceiling plan.
- 2.11 The interior surface of the ductwork connecting to return/exhaust air grilles shall be painted flat black. The ductwork shall be painted a minimum of 24" starting from the grille.
- 2.12 Provide approved flexible connectors at inlet and outlet of each item of heating and cooling equipment whether indicated or not. Install so as to facilitate removal of equipment as well as for vibration and noise control.
- 2.13 All fans and other vibrating equipment shall be suspended by independent vibration isolators.
- 2.14 Miscellaneous accessories such as test openings with covers, latches, hardware, locking devices, etc., shall be installed as recommended by SMACNA and/or as indicated. Test openings shall be placed at the inlet and discharge of all centrifugal fans, VAV boxes, fan sections of air handling units, at the end and middle of all main trunk ducts and where indicated. All such openings shall be readily accessible without damage to finishes.
- 2.15 Whether indicated or not, provide code approved, full sized fire dampers at all locations where ductwork penetrates fire rated walls. Fire stop rating shall meet or exceed the rating of the wall. Provide an approved access panel at each fire damper located and sized so as to allow hand reset of each fire dampers. All such fire dampers and access panels shall be readily accessible without damage to finishes. Refer to Architectural Plans for locations of fire rated walls. All access doors shall be 16"x16" or as high as ductwork permits and 16" in length.
- 2.16 The Contractor who installs the sheet metal shall furnish to the Air Balancing Contractor, a qualified person to assist in testing and balancing the system.

- 2.17 INSULATED FLEXIBLE AIR DUCT: Thermaflex G-KM or equal. Flexible air duct shall be two (2) inch thick fiberglass insulation with CPE liner permanently bonded to a coated spring steel wire helix supporting a fiberglass scrim and fiberglass insulating blanket. Flexible air duct shall be listed under UL Standard 181 as a Class I flexible air duct complying with NFPA 90A and 90B. Maximum flame spread = 25 and maximum smoke developed = 50. Minimum insulating value is R-6.0. Flexible duct shall be used only for GRD runouts and no section shall be more than five feet in length.
- 2.18 FLEXIBLE CONNECTORS: Duro-Dyne, Ventfabrics, Inc., U.S. Rubber or equivalent; conforming to NFPA No. 90A; neoprene coated glass fabric; 20 oz. for low velocity ducts secured with snap lock.
- 2.19 TURNING VANES: Fabricated as recommended by SMACNA: noiseless when in place without mounting projections in ducts. All turning vanes shall be double blade type.
- 2.20 ACCESS DOORS IN DUCTWORK: Flexmaster TBSM, Air Balance, Vent Products or equal. Access doors for rectangular ducts shall be 16"x16" where possible. Otherwise install as large an access door as height permits by 16" in length. Door shall be 2" thick double-wall insulated with continuous hinge and cam lock. Provide in ducts where indicated or where required for servicing equipment whether indicated or not. Provide a hinged access door in duct adjacent to all fire, smoke and control dampers for the purpose of determining position. Access doors shall also be provided on each side of duct coils and downstream side of VAV boxes and CAV boxes.
- 2.21 ARCHITECTURAL ACCESS DOORS IN CEILINGS OR WALLS: Provide Kees D Panel, Cesco, Milcor or equal. Panels shall be 24"x24" in size and constructed with 16 gauge galvanized steel for door and frame. Provide with primer finish to accept specified finish. Door shall include three (3) screwdriver operated cam latches and concealed continuous pivoting rod hinge. Door shall open 175 degrees. For masonry construction, furnish frames with adjustable metal masonry anchors. For fire rated units, provide manufacturer's standard insulated flush panel/doors with continuous piano hinge and self-closing mechanism. The Contractor shall include all required access doors in the bid and shall coordinate with the General Contractor prior to the bid to ensure a complete project.
- 2.22 VOLUME DAMPERS (RECTANGULAR): Ruskin MD35 or Air Balance, Pottorff, rectangular volume dampers. Frames shall be 16 gauge galvanized steel. Blades shall be opposed blade 16 gauge galvanized steel with triple crimped blades on 6" centers. Linkage shall be concealed in jamb. Bearings shall be 1/2" nylon. Maximum single section size shall be 48" wide and 72" high. Provide with Ventfabrics 2" high elevated dial regulator to avoid damper handle from conflicting with duct insulation. Provide permanent mark on dial regulator to mark air balance point.
- 2.23 VOLUME DAMPERS (ROUND): Ruskin MDRS25 or Air Balance, Pottorff round volume dampers. Dampers shall be butterfly type consisting of circular blade mounted to axle. Frames shall be 20 gauge steel and 6" long. Damper blades shall be 20 gauge crimped galvanized steel. Axle shall be 3/8"x6" square plated steel. Bearing shall be 3/8" nylon. Provide with Ventfabrics 2" high elevated dial regulator to avoid damper handle from conflicting with duct insulation. Provide permanent mark on dial regulator to mark air balance point.
- 2.24 FIRE DAMPERS: Fire dampers shall be Ruskin D1BD2 1 1/2 hour rating U-215B vertical 1 1/2 hour rating or D1BD23 for a 3 hour vertical rating. Other acceptable manufacturers are Air Balance or Pottorff. Fire dampers shall be constructed and tested in accordance with UL Safety Standard 555. Each fire damper shall have a 1 1/2 or 3 hour fire protection rating as required by fire wall. Damper shall have a 165 degrees F fusible link, and shall include a UL label in accordance with established UL labeling procedures. Fire damper shall be equipped for vertical or horizontal installation as required by the location shown. Fire dampers shall be installed in wall and floor openings utilizing minimum 20 gauge steel sleeves, angles, other materials, practices required to provide an installation to that utilized by the manufacturer when dampers were tested at UL. Blade and frame thickness shall be a minimum of 24 gauge. Installation shall be in accordance with the damper manufacturer's instructions. The blades shall be out of the air stream.

Provide an access door for fire damper reset at all fire damper locations. Provide factory supplied caulked sleeve, gauge as required to meet manufacturer UL installation requirements. Damper shall be rated for 4" wc and maximum 2,500 fpm.

PART 3 – MEDIUM VELOCITY DUCTWORK:

- 3.1 Medium velocity ductwork shall be utilized for all supply ductwork between air handling unit and VAV/CAV boxes. Provide Eastern Sheet Metal Model "CB" or equal takeoff fitting for each VAV/CAV off high velocity main. Shop or field fabricated takeoffs are not acceptable. Straight tees are not allowed.
- 3.2 Prior to purchase/shipment of the ductwork, manufacturer shall provide as part of the submittal process scaled, field coordinated Autocad drawings of the complete system to be furnished. Drawings will indicate all system components including fittings, ductwork and manifolds. Drawings shall be available in an electronic format.
- 3.3
- 3.4 All round and oval high velocity ductwork for systems above 1.5" W.G. shall be Eastern Sheet Metal, United McGill or Semco or equal as required by the latest SMACNA 4" W.G. Standard.
- 3.5 Ductwork shall be spiral, lock-seam construction fabricated from galvanized steel meeting ASTM-527 standard. Any ductwork exposed to view shall be constructed of galvanized steel. Galvanized metal shall be prepped and clean prior to painting. Coordinate with General Contractor. Ductwork shall be constructed of the following minimum gauges:
- 3.6 All medium velocity duct fittings shall be fabricated by the same manufacturer as the spiral pipe. Contractor or field fabricated fittings shall not be accepted. Duct fittings shall be constructed per the latest SMACNA 4" WG standard with continuous welds. Take-off fittings shall be combination type tees (Eastern Sheet Metal Model "CB" or equal). Straight or angle tees are not acceptable. Fittings shall be constructed of the following minimum gauges.
- 3.7 All single wall ductwork will be furnished with factory installed flanges equal to Eastern Sheet Metal Flange on all ductwork greater than 24 inches in size.
- 3.8 Duct dimensions indicated are required inside clear dimensions.
- 3.9 All ductwork connections, fittings, joints, etc., shall be sealed. Seal with medium velocity, smooth-textured, water based duct sealant. Sealant shall be UL 181B-M listed, UL 723 classified, NFPA IMC compliant, permanently flexible, non-flammable, and rated to 15"wg. Apply per manufacturer's recommendations.
- 3.10 Ductwork shall be installed per the latest SMACNA Medium Pressure Manual, whichever is applicable.
- 3.11 All hanger straps shall be 18 ga. minimum with reinforcement angles installed in strict accordance with SMACNA. Flat oval ducts shall be installed with 2"x2"x¼" angles on top and bottom ducts 18" wide and larger. Use 1"x1"x3/16" angles on ducts under 18" wide.
- 3.12 Miscellaneous accessories such as test openings with covers, latches, hardware, locking devices, etc., shall be installed as recommended by SMACNA or the duct manufacturer, and/or as indicated. Test openings shall be placed at the discharge of all air handling units and at the end and middle of all main trunk ducts and where indicated. All such openings shall be readily accessible without damage to finishes.
- 3.13 Whether indicated or not, provide code approved, full sized fire dampers at all locations where ductwork penetrates fire rated walls. Fire stop rating shall meet or exceed the rating of the wall. Provide an approved access panels at each fire damper located and sized so as to allow hand reset of each fire damper. All such fire dampers and access panels shall be readily accessible without damage to finishes. Refer to

Architectural Plans for locations of fire rated walls. Where access doors are installed in insulated ductwork, the access door shall be the insulated type.

- 3.14 PRESSURE RELIEF DOORS: Provide a pressure relief door in the supply air ductwork at each air handling unit. It shall be located where shown on the drawings. It shall be sized to relieve the duct air pressure below the rated pressure construction of the ductwork and above the working pressure of the fan. The supply air relief door shall be Ruskin PRD18 or equal. Provide a vacuum relief door in the return air ductwork at each return air fan. It shall be located where shown on the drawings. It shall be sized to relieve the duct vacuum below the rated construction of the ductwork and above the working negative pressure of the fan. The return air relief door shall be Ruskin NRD18 or equal. Automatic fan shutdown upon damper closure shall not be an acceptable protection for either overpressure or vacuum conditions. All duct relief dampers shall be of the automatic resetting type.
- 3.15 ARCHITECTURAL ACCESS DOORS IN CEILINGS OR WALLS: Provide Kees D Panel, Cesco, Milcor or equal. Panels shall be 24"x24" in size and constructed with 16 gauge galvanized steel for door and frame. Provide with primer finish to accept specified finish. Door shall include three (3) screwdriver operated cam latches and concealed continuous pivoting rod hinge. Door shall open 175 degrees. For masonry construction, furnish frames with adjustable metal masonry anchors. For fire rated units, provide manufacturer's standard insulated flush panel/doors with continuous piano hinge and self-closing mechanism. The Contractor shall include all required access doors in the bid and shall coordinate with the General Contractor prior to the bid to ensure a complete project.
- 3.16 ACCESS DOORS; IN DUCTWORK: All access doors in round or oval high velocity ductwork shall be screw and gasketed type. Screws shall be maximum 4 inches on centers.

| <u>DUCT DIAMETER</u> | <u>OPENING SIZE</u> |
|----------------------|---------------------|
| 3-4 inches | 4"x10" |
| 5-6 inches | 6"x10" |
| 7-24 inches | 10"x16" |
| 26-36 inches | 16"x16" |
| Over 36 inches | 16"x22" |
- 3.17 FIRE DAMPERS: Fire dampers shall be Ruskin 1BD2 1½ hour rating U-215B vertical 1½ hour rating or United Air Type U-255B for a 3 hour vertical rating. Other acceptable manufacturers are Air Balance or Pottorff. Fire dampers shall be constructed and tested in accordance with UL Safety Standard 555. Each fire damper shall have a 1½ or 3 hour fire protection rating as required by fire wall. Damper shall have a 165 degrees F fusible link, and shall include a UL label in accordance with established UL labeling procedures. Fire damper shall be equipped for vertical or horizontal installation as required by the location shown. Fire dampers shall be installed in wall and floor openings utilizing minimum 20 gauge steel sleeves, angles, other materials, practices required to provide an installation equipment to that utilized by the manufacturer when dampers were tested at UL. Blade and frame thickness shall be a minimum of 24 gauge. Installation shall be in accordance with the damper manufacturer's instructions. The blades shall be out of the air stream. Provide an access door for fire damper reset at all fire damper locations. Provide factory supplied caulked sleeve, gauge as required to meet manufacturer UL installation requirements.

PART 5 – AIR LEAKAGE TESTING OF THE DUCTWORK SYSTEMS:

- 5.1 It is the intent of this section to ensure the ductwork installed has minimal air leakage. Air leakage testing shall be accomplished by an AABC certified company. Refer to the Test & Balance specifications. Whenever the systems are being leak tested by the Test & Balance Contractor, a representative from the Mechanical Contractor shall be present to assist.
- 5.2 Carefully select the ductwork construction requirements and the type of duct sealant to be used as required to meet the leakage allowances. The sheet metal duct pressure classification is a minimum only. The

- Contractor shall select the appropriate sheet metal pressure classification, duct sealant class and duct sealant materials to meet the project air leakage allowances.
- 5.3 The entire outside air unit supply air ductwork system shall be tested with some exceptions. On VAV systems, the medium velocity ductwork upstream of the VAV boxes shall only be tested. Cap the duct at the inlet to the VAV box. .
- 5.4 All toilet exhaust air sheet metal ductwork associated with the system shall be tested. Flexible ductwork shall not be tested. Cap the main duct prior to the central equipment fan connection. Also cap the branch ducts which serve the diffusers, after the round branch air volume with sheet metal caps. Seal caps well to damper to avoid air loss at this location. This air loss, from the caps, is included in the noted leakage rate.
- 5.5 A duct pre-installation conference shall be held prior to the installation of the ductwork. Present should be the Owner, Engineer, Test & Balance Contractor, General Contractor, Mechanical Contractor, Sheet Metal Contractor and Insulation Contractor. At this meeting, the Contractor shall advise all of the duct materials and sealant materials to be used to meet the air leakage allowances.
- 5.6 It is the intent to test all ductwork. The duct systems which will require testing are as follows:
- All outside air unit supply air duct systems.
 - All AHU supply air duct systems
 - All toilet exhaust air duct systems.
- 5.7 Do not insulate the supply air systems prior to testing.
- 5.8 The maximum allowable supply air leakage rate is 2.5% of the systems design CFM when the ductwork is pressurized to 2.5" WG. Therefore, if a supply air system is tested, and the supply air fan rated capacity is 10,000 CFM, the allowable leakage is 250 CFM. The maximum allowable return air and exhaust air leakage rate is 2.5% of the system design when the ductwork is pressurized to 1.50" WG.
- 5.9 The noted allowable leakage rate is the total allowable. It shall include leakage associated with the following:
- All ductwork as described in above paragraphs.
 - Access doors
 - Volume dampers
 - Fire dampers
 - End caps used to seal ducts
- 5.10 If any duct system fails a test, the Contractor shall reseal the system. It shall than be retested until the duct system meets the leakage allowment at no additional cost to the Owner.

END OF SECTION.

DIVISION 23 - HVAC

SECTION 231210 – HVAC SYSTEM CLEANING

PART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.

PART 2 – QUALIFICATIONS:

- 2.1 The HVAC system cleaning Contractor shall be certified member of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.
- 2.2 The HVAC system cleaning Contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems. A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.
- 2.3 The HVAC system cleaning Contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services. The Contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification. For work performed in countries outside of the U.S.A., contractors should comply with applicable national safety codes and standards. The Contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification. Contractor shall submit to the Owner all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.
- 2.4 The HVAC system cleaning Contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations, and licensing requirements.
- 2.5 The HVAC system cleaning Contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA). NADCA Standards must be followed with no modifications or deviations being allowed.

PART 3 – SCOPE OF WORK:

- 3.1 This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.
- 3.2 The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.
- 3.3 The following systems shall be cleaned:
- The supply air system existing ductwork for re-use with AHU-1C and OA-1.

- The return air system existing ductwork for re-use with AHU-1C.
- The exhaust air system existing ductwork for reuse with OA-1

PART 4 – HVAC SYSTEM INSPECTIONS AND SITE PREPARATIONS:

- 4.1 Prior to the commencement of any cleaning work, the HVAC system cleaning Contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.
- 4.2 Damaged system components found during the inspection shall be documented and brought to the attention of the Owner.

PART 5 – GENERAL HVAC SYSTEM CLEANING REQUIREMENTS:

- 5.1 Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.
- 5.2 Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.
- 5.3 All reasonable measures shall be taken to control offensive odors and/or mist vapors during the cleaning process.
- 5.4 Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards. Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.
- 5.5 Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.
- 5.6 The Contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.
- 5.7 The Contractor shall utilize the existing service openings already installed in the HVAC system where possible and add new where needed to properly clean the HVAC system.
- 5.8 Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.
- 5.9 Closures must not significantly hinder, restrict, or alter the air-flow within the system. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system. Openings must not compromise the structural integrity of the system.
- 5.10 Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.

- 5.11 All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the Owner in project report documents.
- 5.12 The Contractor shall remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.
- 5.13 The Contractor shall clean all air distribution devices.
- 5.14 Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
- 5.15 Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Testings (see NADCA Standards).

PART 6 – SAFETY:

- 6.1 Cleaning Contractors shall comply with all applicable federal, state, and local requirements for protecting the safety of the Contractors' employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.
- 6.2 No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.
- 6.3 All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

PART 7 – CLEANING METHODOLOGY:

- 7.1 The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the Contractor's responsibility to select Source Removal methods which will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.
- 7.2 All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.
- 7.3 All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.
- 7.4 All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those which will not potentially damage the integrity of the ductwork, nor damage porous surface

materials such as liners inside the ductwork or system components.

- 7.5 Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).
- 7.6 If there is any evidence of damage, deterioration, delamination, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.
- 7.7 When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.
- 7.8 In the event fiber glass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA.
- 7.9 Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.
- 7.10 Biocidal agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing. Application of any biocidal agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris. Only biocidal agents registered by the U.S. Environmental Protection Agency (EPA) specifically for use within HVAC system shall be used. Biocidal agents shall be applied in strict accordance with manufacturer's instructions. Biocidal coating products for both porous and non-porous surfaces shall be EPA registered, water soluble solutions with supporting efficacy data and MSDS records. Biocidal coatings shall be applied according to manufacturer's instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces. A continuous film must be achieved on the surface to be treated by the coating application. Application of any biocidal coatings shall be in strict accordance with manufacturer's minimum millage surface application rate standards for effectiveness.

PART 8 – CLEANLINESS VERIFICATION:

- 8.1 Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- 8.2 The HVAC system shall be inspected visually to ensure that no visible contaminants are present.
- 8.3 If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the Owner reserves the right to further verify system cleanliness through gravimetric or wipe testing analysis testing as specified herein.
- 8.4 If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

- 8.5 If cleaning deficiencies are observed by the Owner, at the expense of the Contractor, sections of the HVAC system shall be tested for cleanliness using the NADCA Vacuum Test gravimetric analysis as specified in applicable NADCA Standards. Levels of debris collected shall be equal to or less than acceptable levels defined in applicable NADCA Standards. If gravimetric analysis determines that levels of debris are equal to or lower than those levels specified in applicable NADCA standards, the system shall be considered clean and shall have passed cleanliness verification. If gravimetric analysis determines that levels of debris exceed those specified in applicable NADCA standards, the system shall not be considered clean and those sections of the system which failed cleanliness verification shall be re-cleaned at the expense of the HVAC system cleaning Contractor. Gravimetric analysis shall be performed by a qualified third party experienced in testing of this nature.
- 8.6 Cleanliness verification shall be performed immediately after mechanical cleaning and before the HVAC system is restored to normal operation.
- 8.7 Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

PART 9 – POST-PROJECT REPORT:

- 9.1 At the conclusion of the project, the Contractor shall provide a report to the Owner indicating the following:
- Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis. Provide video before and after.
 - Areas of the system found to be damaged and/or in need of repair.

END OF SECTION.

25

DIVISION

BUILDING AUTOMATION SYSTEM

DIVISION 25 – BUILDING AUTOMATION SYSTEMSECTION 250100 - ELECTRIC MOTORS AND OTHER ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENTPART 1 – GENERAL:

- 1.1 The Contractor's attention is directed to the General and Special Conditions, GENERAL PROVISIONS - MECHANICAL and to all other Contract Documents as they apply to this branch of the work. Attention is also directed to all other sections of the Contract Documents which affect the work of this section and which are hereby made a part of the work specified in this section.
- 1.2 Through coordination with other Contractors, Vendors and Suppliers associated with this Project, this Contractor shall ensure a complete, 100% functional, tested, inspected and approved systems. Claims for additional cost or change orders will immediately be rejected. Refer to Specification Section – HVAC EQUIPMENT for additional requirements. All equipment shall be furnished for a single point electrical connection unless specifically excluded as a requirement.
- 1.3 Review the Specification Section - CONTROLS to determine controls, including variable frequency drives, to be furnished.
- 1.4 Prior to ordering any materials or rough-in of any kind, the Mechanical Contractor shall be responsible for final coordination of all electrical requirements (i.e. voltage, phase, circuit breaker, wire sizing, etc.) with the Electrical Contractor. There will be no change in the Contract Amount for any discrepancies. A final coordination meeting shall be held with the Architect, Owner, Engineer, General Contractor, Mechanical Contractor, Electrical Contractor and their sub-contractors.

PART 2 – MOTORS:

- 2.1 The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications and drawing schedules.
- 2.2 Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
- 2.3 Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
- 2.4 Motors shall be capable of frequency of starts as indicated by automatic control system and not less than five (5) evenly time spaced starts per hour for manually controlled motors.
- 2.5 Motors shall have a 1.15 service factor for poly-phase motors and 1.35 service factor for single phase motors.
- 2.6 Motors shall have a temperature rating for 40 deg C ambient environment with maximum 90 deg C temperature rise for continuous duty at full load with 1.15 service factor and Class B insulation.
- 2.7 Unless otherwise noted or required by application, motors shall conform to NEMA Standard MG 1 (Table 12-10) for general purpose, continuous duty, horizontal, T-frame, single speed, design "A" or "B". Utilize design "C" motors where required for high starting torque.
- 2.8 Motor frames shall be NEMA Standard No. 48 or 56. Use driven equipment (fans, pumps, etc.) manufacturer's standards to suit specific application.

- 2.9 Provide inverter rated motors where variable frequency drives are utilized. Motor shall be premium efficiency type with Class F insulation and shall conform to NEMA MG 1 parts 30 and 31. Inverter duty rated motors shall have a temperature rating for 40 deg C ambient environment with maximum of 105 deg C temperature rise.
- 2.10 Motor bearings shall be ball or roller bearings with inner and outer shaft seals. Bearings shall be re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance. Bearings shall be designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
- 2.11 Motor enclosure type shall be open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation. Enclosures shall be guarded drip-proof type motors where exposed to contact by employees or building occupants. Enclosure shall be weather protected Type I for outdoor use or Type II where not housed.
- 2.12 Provide built-in thermal overload protection and, where required, internal sensing device suitable for signaling and stopping motor at starter.
- 2.13 Provide energy efficient motors with a minimum EPACT efficiency in accordance with NEMA MG 1, Table 12-10 for 1800 rpm, enclosed motors. If efficiency not specified, motors shall have a minimum efficiency as listed below:

| | | |
|----------------|----------------|---------------|
| 1 hp - 82.5% | 7.5 hp - 89.5% | 30 hp - 92.4% |
| 1.5 hp - 84.0% | 10 hp - 89.5% | 40 hp - 93% |
| 2 hp - 84% | 15 hp - 91% | 50 hp - 93% |
| 3 hp - 87.5% | 20 hp - 91% | 60 hp - 93.6% |
| 5 hp - 87.5% | 25 hp - 92.4% | 75 hp - 94.1% |
- 2.14 On the motor nameplate, indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

PART 3 – MOTOR STARTERS:

- 3.1 Provide motor starters where indicated on the mechanical equipment schedules or elsewhere in the Contract Documents.
- 3.2 Motor starters shall be NEMA style. Their sizing and installation shall be coordinated with the equipment manufacturer's requirements and in accordance with the National Electrical Code.
- 3.3 All starters shall be size 0 minimum. They shall be constructed and tested in accord with latest edition of NEMA standards. All starters shall be across-the-line magnetic type, unless indicated otherwise. On motors of 20 H.P. or greater rating, the supplier shall provide starters capable of limiting inrush currents. These shall be the reduced voltage open-transition type. Do not utilize closed transition starters unless specifically indicated.
- 3.4 Magnetic starters shall be furnished with the following characteristics and accessories as a minimum. See remaining paragraphs of the Part and mechanical schedules for further requirements.
- 3.5 Contacts shall be silver-alloy, double-break type except NEMA size 8 and 9 shall be single-break type. Contacts shall be replaceable without removal of wiring or removal of starter from enclosure. Number of contacts shall be as required for service indicated. Contacts shall be gravity dropout type, positive operation.

- 3.6 Coil voltage shall be 120 volts, A.C., 60 HZ or less, as required to suit control systems available voltages. Coils shall be of molded construction, except for size 8 and 9 which shall be hand wound. Provide coil clearing contact as required.
- 3.7 Provide control transformer of adequate K.V.A. as required on all starters with line-to-line voltages higher than 120 volts A.C. Provide fuse block and slow-blow fuse to protect control transformer per NEMA, N.E.C. and U.L.
- 3.8 Provide hand-off-auto selector switch in face of starter, wired into hand and off switch positions. Auto position (if needed) to be field wired as indicated for automatic control.
- 3.9 Provide NEMA Class 20 resettable overload relays, accurately sized to the motor nameplate rating of the motor served and the temperature differential between motor and controller. Overloads shall be easily replaceable, and resettable without opening enclosure, via a push button or similar means. Class 10 or Class 30 overloads may be used depending on type of motor duty encountered.
- 3.10 Provide at least one N.O. auxiliary contact (field-convertible to N.C. operation) with each starter. All starters shall have space for two additional single-pole contacts.
- 3.11 All starters shall be thru-wiring type.
- 3.12 Provide phase failure sensing relay to open starter coil circuit (on loss of one or more phases) on all three-phase starters controlling motors of 7½ H.P. or larger.

PART 4 – ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT:

- 4.1 All mechanical equipment shall be provided for single point electrical connection unless noted otherwise.
- 4.2 The equipment manufacturer shall provide internally mounted fuses with the equipment, as required, to comply with the U.L. listing on the equipment name plate. (i.e., hermetically sealed compressors or equipment with name plate data that recommends or requires fuse protection.) See also, National Electrical Code, Article 440, Part C, and other applicable sections of the N.E.C.
- 4.3 It shall be the Contractor's responsibility to assure that all mechanical equipment requiring electrical connections be provided with all required proper wiring, electrical protective devices, disconnecting means and electro-mechanical starting units to properly match the mechanical equipment requirement.
- 4.4 Each separate contractor engaged for the project shall coordinate with all other trades to ensure all necessary equipment and labor is included for fully functioning mechanical systems, installed per Code and Project requirements.
- 4.5 Refrigeration condensing units with internal compressors shall be furnished with integral starter.
- 4.6 All interlock or other control wiring, unless specifically noted otherwise, is the responsibility of this Contractor.
- 4.7 All equipment shall be suitably enclosed. All enclosures for equipment shall be rated and approved for the environment in which it operates. (i.e., NEMA 1, NEMA 3R, NEMA 7, NEMA 12, etc.) Verify the requirement with the installation condition if not indicated on the plans.
- 4.8 Observe the following standards for manufacture of equipment and in selection of components: (1) Starters, control devices and assemblies - NEMA (I.E.C. style not acceptable), (2) Enclosures for electrical equipment – NEMA, (3) Enclosed switches – NEMA, (4) All electrical work, generally NFPA 70, (5) All

electrical work in industrial occupancies - J.I.C. standards, (6) All electrical components and materials - U.L. listing required.

- 4.9 Where scheduled on the drawings, provide disconnect switches and contactors. Disconnect switches shall be fusible type or circuit breaker type.

PART 5 – REQUIREMENTS FOR MECHANICAL EQUIPMENT 3/4 H.P. OR LESS:

- 5.1 This section describes requirements for small mechanical equipment such as (but not limited to) package terminal heating/cooling units, VAV boxes, unit heaters, unit ventilators, exhaust fans, fans, fan coil units, cabinet heaters, DDC temperature control panels, etc.
- 5.2 Small equipment with motor(s) of 3/4 H.P., single phase or less are generally not required to be furnished with starter(s), unless otherwise noted. For such equipment, provide integral contactor or horsepower-rated relay where controlled by thermostat or other type of switch. Contactors or relays shall be as recommended by the manufacturer of the equipment.
- 5.3 Provide transformer within unit as required to provide low voltage A.C. for thermostat control.
- 5.4 Provide internal fusing for unit motor and other loads in fuse block or in-line fuseholder.
- 5.5 Where externally-mounted disconnecting means is required and would be impractical, unsightly or inappropriate in the judgment of the Engineer, disconnects shall be located within the unit. These disconnects may be fusible H.P.-rated snap switches or manual starters with overload elements, as required. Locate this and other electrical equipment within enclosure where easily accessible behind access panel or door on unit, and as acceptable to the electrical inspector or local authority having jurisdiction.

END OF SECTION.

DIVISION 25 – BUILDING AUTOMATION SYSTEMSECTION 250400 - CONTROL - DIRECT DIGITAL (WEB BASED)PART 1 – GENERAL:

- 1.1 The controls system for this project shall be a web-based digital controls system. All controllers, control interface hardware, services, installation, warranty, training, etc., shall be included as hereinafter specified. The system shall utilize a network controller and unitary" type controllers. Including such minor details not specifically mentioned or shown, as may be necessary for the complete operation of the system.
- 1.2 The Temperature Control Contractor (TCC) shall furnish all labor, materials, equipment, and service necessary for a complete and operating Building Automation System (BAS), utilizing Web Based Direct Digital Controls. All labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned shall be included for the complete, fully functional and commissioned temperature controls system.
- 1.3 The TCC shall provide all items, articles, materials, devices, operations or methods listed, mentioned or scheduled on the drawings including all labor, materials, equipment and incidentals necessary and required for their completion to provide a complete and operating temperature control system. This will include connecting to any mechanical equipment furnished with a control interface device and contacting the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished.
- 1.4 These apparatus' shall consist of, but not limited to, all necessary thermostats, sensing devices, valves, automatic dampers, damper motors, actuators, (except automatic dampers, valves, and damper motors furnished with HVAC equipment), and with the necessary accessories for the complete control of all equipment hereinafter specified.
- 1.5 Control sequences are specified at the end of this section. Provide all control equipment required to perform sequences described. Coordinate all dampers with the sheet metal contractor and equipment provider. It is the responsibility of the control contractor to ensure all required dampers in the sequence of operations are provided.
- 1.6 Include all power wiring and cabling for the operation of the controls system. Refer to Electrical Division Specifications for additional requirements.
- 1.7 APPROVED MANUFACTURER'S: Alerton by Open Control Systems, ALC by Local Branch, Siemens Talon by ASA Controls.
- 1.8 The TCC shall have an established working relationship with the control manufacturer of not less than five years and shall have prior approval from the Owner and Engineer and are the only allowed suppliers and/or installing contractors. The TCC shall have a local office within 100 miles of the project site and provide service and/or replacement parts within a 24 hour notification of a control failure.
- 1.9 A mandatory pre-installation meeting shall occur prior to the TCC beginning any work on site. This meeting shall be attended minimally the prime contractor, mechanical contractor superintendent, TCC superintendent, Engineer, Owner and Architect. The purpose of the meeting is to have the controls installer communicate their understanding of the system design and how the system is intended operate to the

Engineer and get the Engineer's input and agreement. The agreement between the TCC and the mechanical engineer is to be thoroughly documented by the TCC for later reference.

- 1.10 The installation shall comply with the Local Authorities and State Fire Marshal code requirements, including normal operating and smoke mode functions (where applicable). The installation shall comply with the requirements of the NEC, NFPA, UL and the Building Codes, including referenced mechanical, electrical, energy codes, etc.
- 1.11 ABBREVIATIONS:
- TCC – Temperature Control Contractor
- 1.12 The TCC shall list the following cost breakdowns, material and labor, on the official project schedule of values:
- Controls shop drawings
 - Controls graphics
 - Controls materials and labor
 - Controls startup, commissioning, testing, documentation (2.5% of controls contract value)
 - Controls training and Owner acceptance (2.5% of controls contract value)

PART 2 – GENERAL SYSTEM REQUIREMENTS:

- 2.1 All labeling for this system shall utilize actual final room names and numbers. The room names and numbers on the Contract Documents may not be the Owner's exact requirements. Coordinate with the Owner to ensure compliance.
- 2.2 Include in the bid for the Controls Contractor to perform additional 40 on-site hours of on-site programming, adjustments, modifications, etc. as requested by the Engineer during the warranty period after the date of substantial completion for the project.
- 2.3 All points of user interface shall be on standard PCs that do not require the purchase of any special software from the control's manufacturer for use as a building operation terminal. The primary point of interface on these PCs will be a standard Web Browser.
- 2.4 The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system integrated utilizing ANSI/ASHRAE Standard 135-2001 BACNet, OBIX TCP/IP, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system
- 2.5 The TCC shall connect to any mechanical and electrical (power monitoring) equipment furnished with a control interface device. The TCC shall contact the equipment suppliers and/or manufacturers for information for the proper interface to the equipment being furnished. All points not provided with the equipment control interface are the responsibility of the TCC.
- 2.6 The operating system shall be based on a distributed control system in accordance with specifications. All building controllers, application controllers and all input/output devices shall communicate via BACnet MS/TP communication protocol. Network controller shall communicate via BACnet over Ethernet (IP).
- 2.7 The TCC contractor shall provide access to the system from a location determined by the Owner and from the Consulting Engineer's office (CMTA, Inc.). This shall include remote access requirements, set-up, passwords and any software necessary to access the BAS system.
- 2.8 The TCC shall all have access to various types of WEB browsers (i.e. Netscape, IE, etc.), which shall be included for access to the Direct Digital Control (DDC) system via the Owner's Wide Area Network (WAN) and/or Local Area Network (LAN).

- 2.9 The TCC shall be responsible for coordination with the Owner's IT staff to ensure that their system will perform in the Owner's environment without disruption to any of the other activities taking place on that WAN/LAN.

PART 3 – SPECIAL PROJECT REQUIREMENTS

- 3.1 Put any special requirements in this section such as allowances, existing conditions modifications, etc.
- 3.2 All BACnet points on this project shall be predefined located in owner's manual and excel spreadsheet. Any special requirements or directions for mapping these points into future 3rd party server/control system shall be included in this project.
- 3.3 Graphics for systems on this phase shall be stored on network controller provided during this phase for graphical interface and troubleshooting.

PART 4 – SUBMITTALS:

- 4.1 The TCC shall not start the project installation until the shop drawing submittals have been reviewed by the Engineer.
- 4.2 Submittals shall include hardware, end devices, ancillary control components, a written operating sequence, unitary control wiring, building floor plans showing communication cabling and labels as well as logic flow diagrams. All submittals shall be provided on paper and electronically in PDF format.
- 4.3 Submittals shall contain one control drawing per specified system and equipment. Drawing shall include point descriptors (DI, DO, AI, AO), addressing, and point names. Each point names shall be unique (within a system and between systems). For example, the point named for the mixed air temperature for AHU #1, AHU #2, and AHU #3 shall not be MAT but should be named AHU#1MAT, AHU#2MAT, and AHU#3MAT. The point names should be logical and consistent between systems and AHU's. The abbreviation or short hand notation (e.g., MAT) shall be clearly defined in writing by the TCC.
- 4.4 Control diagrams shall identify: System being controlled (attach abbreviated control logic text, all digital points, analog points, virtual points, all functions (logic, math, and control) within control loop, legend for graphical icons or symbols, definition of variables or point names and detailed electric connections to all control devices and sensors.
- 4.5 Points list shall include all physical input/output. Points list shall be provided in both hard copy and in electronic format and shall include: Name, address, engineering units, high and low alarm values and alarm differentials for return to normal condition, default value to be used when the normal controlling value is not reporting, message and alarm reporting as specified, identification of all adjustable points and description of all points.
- 4.6 Submittals shall contain floor plans depicting DDC control devices (control units, network devices, LAN interface devices, and power transformers as well as static pressure sensor in duct and temperature sensors in rooms) in relation to mechanical rooms, HVAC equipment, and building footprint.
- 4.7 Submittals shall contain DDC system architecture diagram indicating schematic location of all control units, workstations, LAN Interface devices, gateways, etc. Indicate address and type for each control unit, Indicate protocol, baud rate, and type of LAN per control unit.
- 4.8 Electrical wiring diagrams shall include motor start, control, and safety circuits and detailed digital interface panel control point termination diagrams with all wire numbers and terminal block numbers identified. Indicate all required electrical wiring. Provide panel termination drawings on separate

- drawings. Clearly differentiate between portions of wiring that are existing, factory-installed and portions to be field-installed.
- 4.9 Show all electric connections of the controls system to equipment furnished by others complete to terminal points identified with manufacturer's terminal recommendations.
- 4.10 TCC shall provide one complete drawing that shows the control-wiring interface with equipment provided by others.
- 4.11 Submittals shall include project specific graphic screens for each system including a picture of the screen with a list of the variables to be placed on the screen.
- 4.12 Submittals shall include TCC's hardware checkout sheets and test reports.
- 4.13 Submittals shall include the agenda for approval by the engineer and owner of the specified training periods. See training section for requirements.
- 4.14 Provide complete panel drawings that are:
- Clearly labeled and schematic or drawn to scale.
 - Show the internal and external component arrangement so that the operators can identify the components by their position if the labels come off.
 - Wiring access routes shall also be identified so that Class 1 wiring is separated from Class 2 and 3 and so high voltage wiring is segregated from low voltage wiring.
 - Complete identification of all control devices (manufacturer's type, number, and function).
 - Provide details for labeling all wiring, control devices, and controllers.
 - Material and equipment descriptive material such as catalog cuts, diagrams, performance curves, and other data to demonstrate conformance with specifications shall be provided.
- 4.15 Include room schedule including a separate line for each terminal unit, heat pump, etc. indicating location and address.
- 4.16 Include control valve schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: code number, configuration, fail position, pipe size, valve size, body configuration, close-off pressure, capacity, valve Cv, design pressure, and actuator type.
- 4.17 Include control damper schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: code number, fail position, damper type, damper operator, duct size, damper size, mounting, and actuator type.

PART 5 – O&M MANUALS AND CLOSEOUT DOCUMENTS:

- 5.1 Refer to Mechanical Specification Section – REQUIRED SHOP DRAWINGS, ETC. for additional requirements.
- 5.2 Operating instructions, maintenance procedures, parts and repair manuals shall be supplied. Repair manuals shall include detailed instructions in the setup, calibration, repair and maintenance of all equipment furnished. Also supplied with these manuals will be a complete parts listing of all devices supplied which is to include part numbers and model numbers of all parts and component parts along with exploded views of devices.
- 5.3 All as built drawings (wiring diagrams, flowcharts, floor plans, etc.) shall also be supplied to the owner electronically in PDF format.

- 5.4 System specific wiring, control diagrams, sequence of operation and points lists shall be as installed in each control panel. This means as-built drawings, not design (submittal) drawings.
- 5.5 Supply all software necessary for configuration of, modification, editing or communicating to any of the unitary devices. Software shall be capable of uploading and down-loading the entire unitary data base or any part of the automated system for backup or archiving.
- 5.6 Supply one copy of the software programming manual (hard copy and PDF format). The manual shall describe all furnished software. The manual shall be oriented to programmers and shall describe calling requirements, data exchange requirements, data file requirements, and other information necessary to enable proper integration, loading, testing, and program execution.
- 5.7 Provide a Bill of Materials with each schematic drawing. List all devices/equipment and match to schematic and actual field labeling. Provide quantity, manufacturer, actual product ordering number, description, size, accuracy, operating ranges (voltage, temperature, pressure, etc.), input/output parameters, etc.
- 5.8 Maintenance manual shall include copies of signed-off acceptance test forms, commissioning reports, start-up reports, etc.
- 5.9 The TCC shall turn over to owner two (2) sets of computerized back-ups of the complete temperature control system.

PART 6 – WARRANTY & SOFTWARE LICENSES:

- 6.1 Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after substantial completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner.
- 6.2 The TCC shall respond to the Owner's request for warranty service within 24 hours during normal business hours. The TCC shall respond to the Owner's request for Emergency service (defined as life-threatening or creating the potential to cause property damage) during the warranty period within 4 hours.
- 6.3 The TCC shall provide technical phone support to the owner during the warranty period for warranty related issues and for two years after the warranty period. If the technical support location of the TCC is outside of the toll-free calling area for the customer, the TCC shall have a toll-free number or accept collect calls for the purpose of providing technical support.
- 6.4 During the warranty period, standard parts for the DDC system shall arrive at the facility within 48 hours of placing an order. Non-standard parts (requiring re-manufacturing or ordering from another supplier) shall be shipped within 96 hours.
- 6.5 Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by the TCC shall be provided and correctly installed at no charge during the warranty period.
- 6.6 Provide licensed electronic copies of all software for each workstation, laptop, server. This includes, but is not limited to: project graphic images (editing/modifying/creating), project database, trouble-shooting and debugging programs, project-specific programming code and all other software required to operate and modify the programming code (including software at system level, primary control units, secondary control units, and all communication software). Any hardware devices (cables, protection devices) required to operate the software/hardware shall also be provided.
- 6.7 All additional licensing needed for this project shall be supplied by TCC. Software license shall not expire

or utilize any sort of protection hardware device for its use. In any case owner shall be free to direct the modification of any software license, regardless of supplier to allow open access to all controllers. Owner shall hold the software and firmware licensing. Software license shall not expire or utilize any sort of protection hardware device for its use.

- 6.8 System software shall be the latest version available with upgrades provided at the end of the warranty period, and shall be fully licensed to the Owner for the entire system. Supply all software necessary for configuration of, modification, editing or communicating to any of the unitary devices. Software shall be capable of uploading and down-loading the entire unitary data base or any part of the automated system for backup or archiving. Software shall be "IBM compatible".

PART 7 – TRAINING:

- 7.1 A formal on-site "Hands On" training session shall be conducted for the owner's maintenance personnel. This session shall be a minimum of one (1) eight (8) hour days to train the staff on setup, operation, and maintenance of all system(s) and/or devices. This will be at a time and location selected by the owner. One (1) additional eight (8) hour session shall be provided as "opposite season" training – generally 6 months into the warranty period. One (1) additional eight (8) hour session shall be provided at a later date. (This may be requested any time during the warranty period.) All training materials and books shall be provided. Both sessions shall be given by the manufacturer's "factory" technical representative. (This is defined as someone other than the installing contractor's representative.) All expenses are to be provided by the TCC. All training sessions shall be scheduled at owner's request.
- 7.2 TCC shall conduct training courses for designated personnel in operation and maintenance of system. Training shall be oriented to specific system being installed under his contract and shall be digitally recorded and submitted on DVD by the TCC.
- 7.3 Training shall be a mix of, test exercises, and actual keyboard entry and screen viewing at the operator's terminal. A curriculum shall be discussed and implemented based on the level of expertise of the employees. Hands-on experience and problem solving shall be emphasized.
- 7.4 If during any training session, the trainer/owner finds more than three (3) items that need repair, the training session will be immediately terminated. The session will be rescheduled for another date. The rescheduled training session will be carried out at no additional cost to the Owner.
- 7.5 The training shall be oriented to making the owner self sufficient in the day-to-day use and operation of the DDC system.
- 7.6 Additionally, the training shall include:
- System start-up, shutdowns, power outage and restart routines, alarms, security levels, changing setpoints, changing schedules and other parameters, overrides, freeze protection, manual operation, return to automatic operation, and resetting equipment.
 - All screens shall be discussed, allowing time for questions.
 - Information specifically focused on showing the owner methods of troubleshooting the mechanical systems using the DDC.
 - Use of laptop and hand-held operator interface device, if applicable.
 - Creating, modifying, viewing, downloading, and reloading, trend logs.
 - Remote access to the system.
 - The other training sessions shall be oriented toward answering specific questions from Owner's staff.
 - The trainer must be well grounded in both DDC system operation and in mechanical systems service and shall be the programmer.
- 7.7 This documentation and process shall be complete, approved and accepted by Engineer and Owner prior to

acceptance. This information shall be documented as completed. A copy shall be delivered to the Engineer and Owner and included in the O&M manuals.

PART 8 – COMMISSIONING & VERIFICATION, FUNCTIONAL PERFORMANCE TESTING & CHECKLISTS:

- 8.1 100% compliance with the requirements of this section is a condition of the Owner's acceptance and start of the warranty period.
- 8.2 The TCC shall be responsible for completion of (1) their hardware checkout sheets and test reports, (2) Point-by-point confirmations of ALL points – this includes visual inspection of installed components, and (3) sequence of operation confirmation.
- 8.3 This documentation and process shall be complete, approved and accepted by Engineer and Owner prior to acceptance. This information shall be documented as completed. A copy shall be delivered to the Engineer and Owner and included in the O&M manuals. Each subcontractor shall be responsible for completion of their own System Verification Checklists/Manufacturer's Checklists. Sample checklists shall be submitted to the Engineer and Testing Agent for approval.
- 8.4 Air and water balancing shall be completed (and discrepancies resolved) before the TCC's final system check and before the acceptance test to be conducted in the presence of the Engineer.
- 8.5 Refer to Mechanical Specification Section – GENERAL PROVISIONS for additional information and requirements.

PART 9 – WIRE MANAGEMENT, ELECTRICAL POWER, ETC:

- 9.1 Refer to CABLING section of this specification for additional requirements.
- 9.2 Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.
- 9.3 All wiring and cabling in mechanical and electrical rooms shall be in conduit. No wiring or conduit can be exposed to view in any other area. Conceal all wiring and cabling in conduit in wall from thermostats or other controls devices to above ceiling. Install conduit in wall from wall thermostats to above ceiling for cabling. Route wiring directly to cable tray from control points above the ceiling. Rough-in for control devices shall be in compliance with the requirements of the ELECTRICAL SPECIFICATIONS.
- 9.4 Any power for controls shall be fed from dedicated circuits in emergency electrical panels, when provided for a project, and shall not be obtained from receptacles, lighting, or equipment circuits. Unitary control power may be obtained from the equipment served. If power is obtained from the equipment served, the power may not be interrupted to the electronics if the equipment is off for any reason.
- 9.5 The TCC shall be responsible for the power source to any control panels, unitary controllers, etc. on any controlled equipment and all other control power requirements. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.
- 9.6 Prior to installation, insure through coordination with all trades, that appropriate clearances (36" minimum) as required by the N.E.C. are maintained at all control panels, including unitary controllers for VAV terminals, heat pumps, etc.
- 9.7 The TCC shall provide all CAT5 or CAT6 cabling network cabling for a complete system. This shall include cabling to the Owner's data drop. The main system data drop will be provided by others.

- 9.8 All control circuits within the electrical panels shall be marked to indicate equipment served.
- 9.9 The TCC shall perform all temperature control interlock wiring. This shall include control valves, dampers, thermostats, indoor/outdoor HVAC systems, etc. Electrical work required for system interlock and installation of the temperature control system shall be included in the bid and installed per all applicable codes. Coordinate with other trades as required for installation of a complete system.
- 9.10 The TCC shall be responsible for any power required for the unitary controls or control panels. This includes circuit breakers, wiring, conduit, etc. installed in strict accordance with NEC. The TCC may contract with the electrical contractor for the power wiring installation.
- 9.11 Provide one duplex outlet mounted inside the control panel and separately fused with a non-time delay fuse at 15 A at any panel location containing electronic control components. This receptacle may be served from the control panel 120 VAC power source.
- 9.12 All wiring shall be continuous runs. Any junctions must be made in metal enclosure.
- 9.13 Grounding terminals shall be color coded green and yellow and shall be compatible with the other specialty terminals specified above and shall mount on the same DIN rail system. Units shall be arranged so that the wiring connected to them is grounded to the enclosure via the mounting rail. These terminals shall be provided for grounding cable shields at the points where the cables enter a control panel and terminate on the control panel terminal strip. Terminals shall be Entelec M 4/5.3A.PI or equivalent by Weidmuller, Phoenix, or Allen Bradley.
- 9.14 The Department of Housing, Building and Construction's Electrical Division requires that all new lighting control panels, new Building Automation Systems control panels, and new conventional HVAC control panels be certified as being constructed and wired in accordance with NFPA 70 110.3 (a) (1) and article 409.
- 9.15 Contractor shall ensure control panels have an identification label stating the "Certification Agency" such as UL, CSA, CE, etc. or a label of certification for each control panel by a Professional Engineer (P.E.) registered in the State of Kentucky, stating that the design of the control panel was under their direct supervisory control. Include with shop drawings.
- 9.16 The Electrical Advisory Council for the State of Kentucky requires that only an electrical contractor licensed by the State of Kentucky with a licensed Master Electrician and a licensed on-site electrician can install the electrical wiring for lighting controls systems or Building Automation Systems (BAS).

PART 10 – CABLING:

- 10.1 Refer to WIRE MANAGEMENT section of this specification for additional requirements.
- 10.2 ALL CONTROL WIRING SHALL BE INSTALLED IN A WIRE MANAGEMENT SYSTEM TO INCLUDE CABLE TRAYS, BRIDLE RINGS, & CONDUITS. NO EXCEPTIONS! COORDINATE WITH ELECTRICAL CONTRACTOR TO ENSURE A COMPLETE WIRE MANGEMENT SYSTEM.
- 10.3 Acceptable cable manufacturers are Belden, West Penn or Alpha.
- 10.4 A complete cabling system shall be furnished and installed, which shall adhere to the highest workmanlike standard of quality and appearance. Cabling shall be installed square with building lines and contained within a wire management system.

- 10.5 All sizing of cabling shall be according to manufacturer's recommendations, but shall be a minimum of 18 AWG.
- 10.6 Furnish a floor plan of the building indicating communication cable labeling and routing as well as addresses and branch wiring from the unitary devices. All cabling shall be labeled on both ends. The type, size and label of all cabling shall be indicated on submittal floor plan drawings.
- 10.7 Wall space temperature sensor cabling (from the sensor to the unitary controller) shall have a minimum of four (4) conductors.
- 10.8 All cabling shall be stranded. "NO" solid conductors will be accepted. All cabling shall be 100% shielded with appropriate drain wire and insulation.
- 10.9 All cable connections shall be continuous run (including shield). Any junctions must be made in a metal enclosure, connections must be soldered, taped and the metal enclosure must be mechanically attached to the nearest ground. No wire nuts or crimped connections will be accepted. Note location of junction boxes on the as built floor plans. All cabling networking unitary controllers, and other networked equipment, shall be in soldered.
- 10.10 All shields must be terminated as per manufacturer's recommendation. Shield termination requirements by the manufacturer must be provided with submittals.
- 10.11 Wireless controllers are not approved unless specifically mentioned in the sequence of operations or noted on plans.

PART 11 – SYSTEM SOFTWARE:

- 11.1 System software will be the latest version available with upgrades provided for full warranty period, and shall be fully licensed to the owner for all network controllers and servers. Refer to WARRANTY section of this specification for additional requirements.
- 11.2 The BAS shall include trend logging screens accessible from tabs on the home page for building utilities usage.
- 11.3 System software shall, at a minimum, provide:
- Monitor and supervise all control points.
 - Add new points and edit system database.
 - Change control setpoints, timing parameters and loop tuning of PID coefficients in all control loops in all control units.
 - Enter programmed start/stop schedules.
 - View alarm and messages.
 - Modify existing control logic (or sequence of operation) in all control units.
 - Upload/Download programs, databases, control parameters, etc.
 - Modify graphic screens.
- 11.4 Sequence of operation programming methodology - The application software shall be user programmable. Application programming shall be (1) Line type programming that uses text programming in a language similar to BASIC or FORTRAN, or (2) graphical block programming - The method of programming shall be by manipulation of graphic icon "blocks." Each block represents a subroutine containing the programming necessary to execute the function of the device that the block represents.
- 11.5 Unitary Control Unit Database Archiving - The host software shall provide capability to upload sequence of operation, database, and other control parameters from each controller. Uploaded programs shall be retained on hard disk for system backup. Programs may be modified using Editor functions, and

downloaded to individual controllers as desired. Downloading of databases shall not interrupt other multi-tasked functions that are ongoing.

- 11.6 THIRD PARTY SOFTWARE PACKAGES: The host software shall provide the capacity to run third party software packages for word processing, spreadsheets, or database management programs. Use of third party software shall not suspend operation of background tasks of multi-tasking operating system, such as alarm logging, and report generation.

PART 12 - DIRECT DIGITAL CONTROLLER (DDC)

12.1 General:

- 12.1.1 Install the DDC Controller in a surface mounted panel, NEMA type 1 enclosure unless noted otherwise, with a removable hinged door. Provide a flush mounted key lock. All control panels must be painted the same color and identified. The boxes are to be made from 16 gauge material. Panels should not be provided with knockouts.
- 12.1.2 Enclosures must be appropriately rated and properly installed and for their intended use. Enclosures installed in areas where subject dripping or light splashing should be NEMA12.
- 12.1.3 Unless otherwise specified, each piece of equipment shall have its own DDC Controller (i.e., heat pump, DOAS, terminal unit, etc.). The DDC Controller for each piece of equipment shall be mounted on the side of the unit or on a nearby wall (refer to plans for DDC Panel Locations). The DDC Controller for all other equipment shall be mounted in a panel and properly labeled.

12.2 DDC Controllers

- 12.2.1 The DDC Controller shall be web-based and communicate using the BACnet IP protocol, as defined by ASHRAE Standard 135-2004. No gateways shall be used for communication to controllers furnished under this section. A sub-network using the BACnet IP and BACnet MS/TP (if IP is unavailable for 3rd party devices) protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- 12.2.2 DDC Controllers utilized in the network shall have full stand-alone capability including all energy management functions such as optimal start/stop, duty cycling, etc. The terminal unit Unitary Controllers may be pre-programmed with the project specific sequence of operation as specified for the application. Any re-programming of the electronics shall be performed on location using a portable personal computer with appropriate software or through the DDC Controller. The entire unitary data base shall have the capability of being backed up and or downloaded locally.
- 12.2.3 All Unitary Controllers shall be fully application programmable. All control sequences within or programmed into the unitary controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery shall be retained.
- 12.2.4 All unitary controllers shall be fully application programmable. Controllers require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the unitary controller shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
- 12.2.5 After a power failure, the Unitary Controller shall operate the control application using the current setpoints and configuration. Reverting to default or factory setpoints are not acceptable.
- 12.2.6 Digital expanders, multiplexers or other devices which gang multiple signals into or out of a signal point are not allowed. Each input or output called for shall have its own discrete point on the controller. All

points to have a unique digital input to the BAS system. The use of digital point count expanders is not an acceptable replacement to digital inputs to the unitary controller. The conversion of a single universal input channel to accept up to multiple voltage free contacts such as relay contacts, auxiliary starter contacts, differential pressure switches, etc. IS NOT ACCEPTABLE.

- 12.3 Network DDC controllers (connected to a sub-net of BACnet IP or factory MSTP controllers)
 - 12.3.1 The Network DDC Controller with a sub-net of other DDC controllers shall be a fully user-programmable, supervisory controller. It shall monitor the network of distributed DDC controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other DCC Controllers.
 - 12.3.2 The DDC Controller shall be composed of one or more independent, stand-alone, microprocessor to manage the network strategies described in Application software section. The network DDC controller shall have ample memory to support its operating system, database and programming requirements. The operating system of the Network DDC Controller shall manage the input and output communications signals to allow distributed unitary controllers to share real and virtual point information and allow central monitoring and alarms. The database and custom programming routines of the Network Controller shall be editable from a single operator station.
 - 12.3.3 Network DDC Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
 - 12.3.4 The Network Server Controller shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.
 - 12.3.5 They shall also be responsible for monitoring and controlling their own HVAC equipment such as a VFDs.
 - 12.3.6 They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces.
- 12.4 The BACnet IP or MSTP DDC controller for Variable Air Volume (VAV/ OAV/FVAV) applications
 - 12.4.1 The BACnet/ IP or MSTP Fieldbus controller for VAV applications shall include a built-in 'flow thru' differential pressure transducer
 - 12.4.2 The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of $\pm 5\%$ at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within $\pm 5\%$ of setpoint at the specified minimum and maximum air flow parameters
 - 12.4.2.1 The controller for VAV applications shall support a dedicated commissioning tool for air flow balancing
 - 12.4.2.2 The controller for VAV applications shall require no programing for air balancing algorithm
 - 12.4.2.3 All balancing parameters shall be synchronized in NSC
- 12.5 The BACnet DDC controller for remote IO
 - 12.5.1 The system shall have available a BACnet fieldbus controller to support inclusion of IO that is remote from the controller(s) that may need it.
 - 12.5.2 As the controller is just an IO 'station' handling data to other controllers it still shall:
 - 12.5.3 Support local alarms and local trends

- 12.6 The controller shall be provided integral vided with a rechargeable battery back-up or Electrically Erasable Programmable Read Only Memory (EEPROM) with a 30 day capability to protect against loss of time in the calendar clock and the programmed software and provide surge protection on the head end terminal.
- 12.7 Under no circumstance shall more than 80% of the total number of sensor and control points be connected through a single Network DDC Controller. Each DDC system component shall provide for the future addition of at least 20% of each type of the number of sensor and control points connected to that component including a minimum of one universal input and one universal output.
- 12.8 All points to have a unique digital input to the BAS system. The use of digital point count expanders is not an acceptable replacement to digital inputs to the unitary controller. The conversion of a single universal input channel to accept up to multiple voltage free contacts such as relay contacts, auxiliary starter contacts, differential pressure switches, etc. IS NOT ACCEPTABLE.
- 12.9 Architecture
- 12.9.1 The TCP/IP layer connects all of the buildings on a single Wide Area Network (WAN) isolated behind the District firewall. Fixed IP addresses for connections to the District WAN shall be used for each device that connects to the WAN.
- 12.9.2 The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.
- 12.9.3 All DDC controllers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the DDC controller shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.
- 12.9.4 A sub-network of DDC controller using the BACnet IP, BACnet MS/TP and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- 12.9.5 The DDC Controller shall be integrated and interoperable with the facility infrastructure and include user access to all system data locally over the Local Area Network (LAN) / Wide Area Network (WAN) within the building and remotely by a standard Web Browser over the Internet. Any computer connected to the network, utilizing a web browser and having the proper password.
- 12.10 Naming and describing data points associated with facility automation systems. To allow standardization the naming will utilize the Haystack based on data tagging to map to a future server with
- 12.10.1 The DDC controller shall provide "tag" for points that are incorporated into the Project Haystack based on data tagging ", and common vocabulary of tags so that building equipment systems and smart devices can be "marked up" with meta data to describe their meaning and characteristics. The current library of standard tags shall be in accordance with: <http://project-haystack.org/tag>.
- 12.10.2 The open-source license shall use the Open Source Initiative Academic Free License 3.0 model. Full details on the terms of the license are available at: <http://project-haystack.org/doc/License> and <http://opensource.org/licenses/AFL-3.0>
- 12.10.3 The building equipment systems and/or automation systems controlling them shall employ a simple meta-model methodology based on the broadly accepted concept of "tags" as described below.
- 12.10.3.1 Tags: Tags are name/value pairs, associated with entities like AHUs, electric meters, etc. Tags are

simple and dynamic, add structure, and provide the flexibility needed to establish standardized models of diverse systems and equipment. Tags are a modeling technique that allows easy customization of data models on a per-task, per-project or per-equipment basis, while retaining the ability to be interpreted by external applications using a standard, defined methodology and vocabulary. Tags shall support the definition of the following essential data elements:

- 12.10.3.2 Entity: An Entity is an abstraction for a physical object in the real world. Entities include sites, facilities, equipment, sensor points, weather stations, etc. In software systems, an entity might be modeled as a record in a database, an object in a building automation system, or maybe just a row in a csv file or spreadsheet.
- 12.10.3.3 Id: The id tag is used to model the unique identifier of an entity in a system using a Ref value type. Ref value types are determined by individual application. The scope of an entity may be undefined, but must be unique within a given system or project. This identifier may be used by other entities to cross-reference entities, associations, and systems.
- 12.10.3.4 Dis: The dis tag is used with entities to define display text used to describe an entity. Dis values are intended to be short (less than 30 or 40 characters), but fully descriptive of the entity for a human user.
- 12.10.3.5 Additional tags are used to describe facts, associations and other characteristics of the data items associated with the equipment systems.
- 12.10.4 Utilize the Project Haystack Standard Library of Tags and Library Extensibility: The data modeling standard shall provide a comprehensive library of standard tags to address common equipment, building systems, and devices types. The standard shall be developed by an open-source community through means of an open discussion forum to enable industry experts and interested parties to discuss, submit, fine-tune and eventually approve additional tags or standard schemas to address equipment, systems, and applications of numerous types. The open forum process shall be transparent to enable continued development of a taxonomy that will enable semantic understanding of facilities engineering data across and outside of the industry.

PART 13 – SENSORS AND MISCELLANEOUS DEVICES:

- 13.1 WEATHER STATION HOUSING: Provide Kele Model A21 Outdoor Aspirated Humidity/Temperature housing. NEMA 3R enclosure is painted white to reduce the effect of radiation, and the enclosure has a lockable latch for security. The outdoor air sensor will be installed on the north wall in the shade as not to be affected by sunlight, building ventilation or weather. This location shall be indicated on the control drawings. Installation in outside air ductwork or louvers is not acceptable. If not installed to provide "accurate" temperature readings, it shall be relocated (at the TCC's expense) until a suitable location is found.
- 13.2 SENSOR RESOLUTION: All temperature sensors shall have a minimum resolution of 1/10th of 1 degree F. (0.1 degree F.) Sensor stability shall be 0.24 degrees over a year period. Space sensors shall be tested and accurate to within 0.75 degrees F. Outside air, water and duct sensors shall be tested and accurate to within 2.0 degrees F.
- 13.3 SPACE SENSORS AND THERMOSTATS:
- Refer to the drawings for proper type and location.
 - All thermostat and sensors shall be provided with temperature indication, unless otherwise noted.
 - Programmed set-point shall be locally adjustable limited to 2 degrees above set-point and 2 degrees below set-point for supervised areas.
 - Unsupervised areas shall have non-adjustable set-point.
 - Generally, thermostats/sensors shall be installed 5'-0" above the finished floor.

- Where thermostats/sensors are to be mounted next to a light switch, install at the same height as the light switch.
 - Sensors in hallways, vestibules, stairways, restrooms and locker rooms shall utilize a stainless steel surface mount temperature sensor installed on an interior wall or partition (2"x4" blank plate). Care must be taken in the installation of these sensors to ensure proper insulation from the wall temperatures in order to properly sense space temperature.
 - If there is a question consult engineer prior to rough-in.
- 13.4 WATER SENSORS: Temperature sensors for water lines are to be the well type. Wells are to be threaded brass (same manufacturer as the temperature sensor) with the sensor coated with a heat transfer compound. Strap on sensors will not be acceptable.
- 13.5 MIXED AIR SENSORS: These sensors shall be bendable averaging, type made of copper or aluminum elements. In unit ventilators, these sensors shall be at least five (5) feet in length and installed in the discharge air of the unit. For Air Handling Units, Outside Air Units, etc. the sensors shall be at least 20 feet in length.
- 13.6 DISCHARGE AIR AND DUCT ROOM RETURN AIR SENSORS: Shall be rigid insertion type. In all applications, care shall be taken to ensure that the sensors are securely mounted as not to allow any vibration and installed in such a manner as to indicate the truest possible temperature.
- 13.7 FREEZE/LOW-LIMIT THERMOSTAT: Provide a freeze/low-limit thermostat in each Air Handling Unit, Outside Air Unit, etc with a water coil for freeze protection. These devices shall be the manual reset type. This device shall be wired by using a normally closed contact in series with the motor starting circuit and a normally open set of contacts as an input to the unitary controller. The element shall be constructed of copper and be at least 20 feet in length. It shall be installed serpentine across the air entering the coil. In some cases it may require being installed after the coil. Each application should be closely evaluated before installation. The device shall sense the lowest temperature by any one foot section of its element.
- 13.8 COMBINATION TEMPERATURE/HUMIDITY SENSORS: All temperature sensors shall have a minimum resolution of 1/10th of 1 degree F. (0.1 degree F.) Sensor stability shall be 0.24 degrees over a year period. Space sensors shall be tested and accurate to within 0.75 degrees F. The humidity sensing device shall be 100% solid state, linear and temperature compensated with a 0-100% RH range. The response time shall be a minimum of 30 seconds for a 60% change. They shall have a minimum of 2% accuracy minimum accuracy of +/-2% RH minimum rangeability 5 to 95% RH non-condensing and maximum hysteresis +/- 1.5% RH. Do not submit products that do not meet this range. The output of the device must utilize a 0-10 VDC or 4-20mA signal as required. The device must use a power supply of 24 VAC or VDC. Duct mounted sensors shall have at least 4" insertion probe with a 16 gauge steel enclosure. NIST traceable certification shall be provided to the Engineer as part of the shop drawings. For wall mounted sensors the enclosure shall be polystyrene plastic mounted next to and at the same height as the temperature sensor in that area. Both shall have the same appearance. Provide protective cages in fitness and common areas.
- 13.9 LOW PRESSURE TRANSDUCERS: These devices shall be 100% solid state, linear and temperature compensated. Accuracy shall be no less than plus or minus 1% of its full range. Linearity, repeatability and hysteresis shall be no less than plus or minus 0.1%. All pressure sensors shall utilize output averaging/output clipping to adjust and stabilize any fluctuations in the output. The output of the device shall utilize a 0 - 10 VDC signal. The device shall use a power supply of 24 VAC or VDC. The enclosure 16 gauge steel. For sensing internal static pressure of air handling ducts utilize sensors with a range of 0 to 5 inches water column. For sensing building static pressures (building compared to atmospheric) utilize a sensor with a range of -0.25 to +0.25 inches water column.
- 13.10 RELAYS: Relays for starting and stopping fractional horsepower motors shall be rated as follows:
- 1/4 horsepower motors or less use 15 ampere rated relays,

- 1/3 horsepower motors use 20 ampere rated relays,
 - 1/2 horsepower motors use 30 ampere rated relays,
 - Relays used for pilot duty service shall be rated at a minimum of 10 amperes.
 - Provide auxiliary pilot duty relays on motor starters as required for control function.
 - Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- 13.11 CENTRAL STATION AIR HANDLERS: All Central Station Air Handlers, Outside Air Units, etc shall be provided with a D.A.P. (differential air pressure) switch across each the supply fan to provide fan status for each air handler.
- 13.12 SMOKE SHUTDOWN: All AHUs, OA units, Heat Pump Units, etc with fans of greater than 2,000 CFM are required to have smoke shutdown safeties as required by the Building Code. These smoke detectors shall have a set of auxiliary contracts wired to a dedicated input of the Unitary to provide status of the smoke detector. All units must be provided with a current sensor to provide fan status for each air handler. For projects with Outside Air (OA) units, any system fire alarm activation shall shutdown all OA units. Coordinate with the Fire Alarm Contractor to ensure a complete, code compliant installation.
- 13.13 CURRENT SENSING DEVICES: Veris Industries model Hx08 Series and H701 or equal. All current sensors shall be capable of alarming to the BAS for belt losses, pump coupling shear or other mechanical failure on loads.
- 13.14 DIFFERENTIAL PRESSURE TRANSMITTERS: Provide Rosemount (ITT Bell & Gossett ST-102R) or Johnson Controls Setra DPT 2302-050-V field mounted differential pressure sensor transmitters as indicated on the plans. Range shall be 0-25 psig. Accuracy shall be .025% full span.
- 13.15 CARBON DIOXIDE SENSORS: This sensor shall have a range of 0-2000 ppm +/-5% and +/- 50 ppm. Analog output of 0-10 or 2-10 VDC. Power shall be 24VAC. Calibration interval rated for 5 years. Sensor shall not be provided with a digital display. Honeywell Model C7232 or equal. A replacement CO2 sensor shall be installed annually for 5 years after substantial completion by the control's contractor. Provide with LED display.

PART 14 - VALVES, DAMPERS AND ACTUATORS:

- 14.1 Unless otherwise specified, valves shall be furnished and sized by the TCC. The valves are to provide the required capacity and the close off rating shall be in excess of the system pressures encountered (minimum 40 psi differential). Proportioning-type valve bodies shall be packed type with throttling type inner valve (quick close plug shall not be acceptable). Proportional type valves to be rated at 125 psi static pressure. Modulating control valves shall be selected within a 3-5 psig pressure drop range. Two position control valves (open/close) shall be line size.
- 14.2 Dampers for various units requiring field mounting shall be tight closing, "ultra low leakage", opposed blade with side and edge seals. They shall be sized and furnished under this section. Installation of dampers shall be by the sheet metal contractor, coordinated by the TCC. Frames shall be no less than 16 gauge galvanized steel and furnished with mounting holes for duct mounting. Damper blades shall be no less than 14 gauge galvanized steel with maximum blade width of 8 inches. Blades shall be secured to 1/2 inch zinc plated axles and hardware with nylon bearings. Provide thrust bearings at the end of each blade. **All dampers shall have end switches to positively prove damper position. No Exceptions!**
- 14.3 All damper and valve actuators shall be fail safe spring return type with sufficient force to operate the dampers or valves under all normal operating conditions. They shall return to the normally open position upon a loss of power. Exceptions to the spring return applications are (1) face and bypass actuators, (2)

boiler 3-way loop mixing valves, (2) boiler room seasonal changeover valves. Actuators for fan coil units, terminal units, etc. shall fail in the last position.

- 14.4 "ALL" Actuators shall be of the same manufacturer and have internal feedback circuitry to provide a positive action to ensure proper positioning of the damper or valve through the entire sequence. Actuators shall have an adjustable starting point to accurately set the range of travel to the output of the controller. All actuators shall also utilize the same input signal (6-9 VDC, 0-010V, 2-10 VDC, 4-20 MA) in order to maintain some consistency in the control application. Analog actuation is 6-9 VDC, 0-010V, 2-10 VDC or 4-20 MA, floating point control with 2 digital outputs is NOT approved as analog actuation.
- 14.5 Actuators may be factory installed. If not factory installed they shall be installed as per instructions by the terminal equipment manufacturer.
- 14.6 Locations mounted above ceiling shall be marked on ceiling grid.
- 14.7 Install damper motors on the outside of the duct in warm areas where possible, not in air stream or locations exposed to outdoor conditions.

PART 15 – OPERATOR INTERFACE AND SERVER:

- 15.1 The TCC shall provide a PC to the Owner.
- 15.2 Include one portable computer with carrying case in the bid as follows:
- Processor: Processor, 2.4 GHz or higher.
 - Operating System: Microsoft Windows XP Professional, Windows2008 Server or Windows 7 Professional, 64 bit
 - Memory: 4GB DDR3 SDRAM at 1333MHz
 - Hard Drive: 320 GB SATA minimum
 - Screen: 17" HD LED screen (1600x900), anti-glare
 - Video Card: HD Graphics 3000 with up to 1.6GB Dynamic Video Memory
 - Optical Drive: 8X DVD+/-RW with double-layer DVD+/-R write
 - Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector)
 - Wireless Network Support: wireless 802.11b and 802.11g protocols must be supported
 - USB Mouse
 - 90W AC adapter and 6 Cell Lithium Ion Battery
 - Carrying case with strap
- 15.3 Provide uninterruptible power supply (UPS) for all major components. This includes all front ends, routers, servers and control workstations on site.

PART 16 - VARIABLE FREQUENCY DRIVES (VFDs):

- 16.1 The work includes all labor, materials, and related items to completely furnish and install, start up and test, and place into service the Variable Frequency Drives (VFDs) indicated and scheduled on the Drawings and described in the Specifications.
- 16.2 VFDs shall be as manufactured by ABB, Graham/Danfoss, or Square D. These are the only acceptable manufacturers. All VFDs for the project shall be by the same manufacturer (no exceptions).
- 16.3 VFDs shall be consist of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.
- 16.4 The VFD shall be capable of operation form AC voltage in two rages 208–240 VAC \pm 10%, or 380–480

VAC \pm 10%. 50/60 HZ operation, \pm 2 hertz.

- 16.5 The VFD enclosure shall be rated UL type 1 and shall be UL listed as a plenum rated, suitable operating conditions: 0 – 40⁰ C continuous. Drives that have thermal cut out circuits, or that cannot operate continuously at 40⁰ C shall not be acceptable. Altitude 0 to 3300 feet above sea level, up to 95% humidity, non-condensing.
- 16.6 The VFD shall produce an adjustable AC voltage/frequency output for step less motor speed control utilizing sine wave coded Pulse Width Modulation (PWM) The Drive shall provide automatic power factor correction and a .98 displacement power factor by incorporating a full wave diode bridge rectifier. The VFD shall have an overload rating of 110% of nominal rated current for 1 minute out of every 10 minutes of operation, which is an acceptable overload for centrifugal loads.
- 16.7 The VFD shall include a built-in first environment RFI/EMI filter and be CE and UL labeled. It shall also meet the CE requirement of EN61800-3 which provides an actual test procedure that shows that the VFD is immune from RFI/EMI interference and at the same time does not emit RFI/EMI noise that would interfere with other sensitive equipment near the VFD.
- 16.8 The VFD shall include as a minimum a 5% dual DC link or AC line reactor for a clean harmonic signature, which aides in complying with IEEE-519-1992 recommended levels. The VFD manufacturer and representative shall assist in ensuring that the VFD's applied meet IEEE-519-1992 by completing a computer aided Harmonic Analysis of the complete system.
- 16.9 The VFD shall include as a standard a built-in digital keypad/display panel. This panel shall provide "Hand" off "Auto" selection, and a manual speed adjustment via up and down arrows. All faults and warnings shall be provided in "Plain English" for operation without a manual. The drive shall have a complete manual stored in memory that can be accessed with a single keystroke. This display shall be password protected and allow all setup parameters to be adjusted only by authorized personnel.
- 16.10 The VFD shall include built in Startup, Diagnostic, and Maintenance assistants, which allow for step-by-step startup procedures, troubleshooting, and the ability to indicate when the VFD and the system it is applied to needs preventive maintenance performed.
- 16.11 The VFD shall include a real time clock with a day/date stamp for troubleshooting purposes. In addition, with the use of this clock the drive shall be capable of stand-alone operation and act as a unitary controller.
- 16.12 The VFD shall include (2) Analog inputs either 4–20 mADC or 0-10 vdc, (6) programmable Digital Inputs, (2) Programmable analog Outputs, (3) Form C Relay output rated 2 amps continuous minimum, and (2) PID Process controllers.
- 16.13 The VFD keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (LED and alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words.
- 16.14 **BYPASS:** As scheduled on the drawings, the drive shall be provided with an integral Bypass circuit which includes a pair of 115V electrically interlocked contactors for drive and bypass operation. The drive shall include a main input circuit breaker, drive input service/isolation switch, and motor overload protection adjustable for either Class 10, 20 or 30 operation. The bypass shall include a built-in status display which shows via colored LED's the system operational status including safeties and run permissive for ease of operation. The Bypass shall have its own interactive, programmable keypad. The Bypass shall provide single-phase protection for the motor while operating in bypass. Bypass that does not protect the motor from single-phase operation shall not be acceptable.
- 16.15 The drive and bypass system shall have embedded serial communication capabilities that allow direct

- connection to Modbus, Johnson Controls, Siemens and BACnet automation systems as part of the drives software suite without the need for extra hardware cards or gateways. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC).
- 16.16 All VFDs shall be provided and installed in strict accordance with the manufacturer's recommendations.
- 16.17 Factory-authorized startup for each drive is mandatory. Provide a written record of the startup of each unit. Start up and programming by a factory-authorized technician. At startup, lockout any speed with the VFD that does not meet the vibration allowed of the equipment manufacturers.
- 16.18 A parts and labor warranty of **3 years from startup and 2 years from the date of substantial completion** shall be included. Warranty shall include travel time and expenses.

PART 17 – GRAPHICS SCREENS AND TRENDS:

- 17.1 All graphics screens shall be submitted for review by Engineer. Provide the following animated, color graphics screens minimally:
- 17.2 Entire floor plan home screen with OAT, Time and Date displays.
- Floor plan showing major zones,
 - Click major zone displays enlarged floor plan of the zone showing individual heat pump zones & numbers. Include link to respective mechanical room.
 - Click individual zone shows heat pump graphic. Display all data points from points list, occ/unocc schedule and setpoints, VAV cfm and setpoint, OAT, Time and Date.
- 17.3 Color Graphic Screens shall be designed for all mechanical systems and shall include the following:
- A graphic shall be the starting page with the building graphically indicated. Break up the floor plan into zones to match Contract Documents. The building shall be the point of reference to enter into the respective building control system.
 - All fan coil units and associated VAV boxes, etc.
 - All terminal equipment including but not limited to VAV boxes, reheat coils, zone dampers, etc.
 - All OA units.
 - All AHUs
 - The summation of all supply OA for each unit shall be displayed on the AHU graphic pages.
 - All floor plans indicating all actual room numbers, thermostats and mechanical equipment. Operator shall be capable of clicking on any equipment and pull up the respective graphic screen.
- 17.4 Graphics to include floor plans with room numbers (as-built room numbers) and thermostat locations, links to flow diagrams for fan coil units, outside air systems, etc.
- 17.5 All new graphics shall match the existing system graphics, unless noted otherwise.
- 17.6 The graphical programming software shall allow for interactive mouse-driven placement of block icons on the graphic screen and connection of block inputs to block outputs by means of drawing lines to form a graphic logic diagram. The user shall not have to manually input text to assign block input/output interconnections. Blocks shall allow entry of adjustable settings and parameters via pop-up windows.
- 17.7 The clarity of sequence shall be such that the user has the ability to verify that the system programming meets the specs without having to learn or interpret a manufacturer's unique programming language. Provide a means for testing and/or debugging the control programs off-line (not communicating with control units) using operator entered values for physical inputs and time. Provide a means for testing and/or debugging the control programs on-line (communicating with control units), showing actual physical inputs and all block outputs in real time.

- 17.8 Provide a utility that shall allow the graphic logic diagrams to be directly compiled into application programs. Logic diagrams shall be viewable either off-line, or on-line with real-time output values.
- 17.9 All graphic software shall be in the html web browser format and support multiple simultaneous screens to be opened and resizable in a "Windows" type environment. All functions, except text entry, shall be executable with a mouse. Graphic software shall provide for multitasking such that third party programs can be used while the Operator Workstation Software is on-line. Provide the ability to alarm graphically even when operator is in another software package. The software shall allow for Owner to create user defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics.
- 17.10 The contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, coils, filters, dampers, etc.), mechanical system components (e.g., pumps, heat pumps, etc.), complete mechanical systems (e.g. VAV, etc.) and electrical symbols.
- 17.11 The graphic development package shall use a mouse or similar pointing device to allow the user to perform the following:
- Define symbols
 - Position items on graphic screens
 - Attach physical or virtual points to a graphic
 - Define background screens
 - Define connecting lines and curves
 - Locate, orient and size descriptive text
 - Define and display colors for all elements
 - Establish correlation between symbols or text and associated system points or other displays.
 - Create hot spots or link triggers to other graphic displays or other functions in the software
- 17.12 The TCC shall including programming of 25 point trends as directed by the Engineer. These can be requested at any time during the project including the warranty period. Trend "change of state" for digital inputs. Trend analog points in 30 minute increments. Maintain trend history for 30 days. Include the following:
- Outside air temperature
 - OA unit leaving air temperatures for each unit
 - Summation of all VAV boxes connected to a unit
 - VFD speeds (OA & EA)
 - FCU Discharge air temperature
 - Others as directed in the field

PART 18 - TIME SCHEDULES (ALL TIMES SHALL BE USER ADJUSTABLE):

- 18.1 During construction, the time schedule (for all equipment except OA unit) will be Occupied at 5:00 AM, Unoccupied at 10:30 PM. seven (7) days a week.
- 18.2 When the system is fully tested and operational and after the Owner's staff have been fully instructed as to the operation of the system the schedule shall be as follows unless otherwise instructed:
- 18.3 CLASSROOM AREAS: Monday through Friday Occupied mode at 7:15 AM, Unoccupied mode at 3:30 PM. Unoccupied for Saturday and Sunday. Stage Classrooms in Area B on first, Area C on 15 minutes later and all other spaces 15 minutes after Area C.
- 18.4 Administration areas: Monday through Friday Occupied mode at 7:00 AM, Unoccupied mode at 4:00 PM. Unoccupied for Saturday and Sunday.

- 18.5 Cafeteria: Monday through Friday: Occupied mode at 7:15 AM, Unoccupied at 12:30 PM. Unoccupied for Saturday and Sunday.
- 18.6 Building outside air handling unit shall operate Monday thru Friday, 7:50 AM to 2:40 PM.
- 18.7 Each piece of equipment shall have its own adjustable time schedule.
- 18.8 All schedules shall be coordinated and confirmed with the Owner prior to final implementation.

PART 19 - REFRIGERANT MONITORING SYSTEM:

- 19.1 Provide a Vulcain model VA301EM-20 Control Panel and model VA301EMRP-20 Annunciator Panel or approved equal. The system and installation shall comply with all applicable code requirements including ASHRAE 15.
- 19.2 Panels shall communicate digitally with the networked transmitters. Control panel shall communicate with an Annunciator Panel that will serve as a dummy controller within a secondary control room. The panels will indicate the exact concentration of gas, the gas detected and the location of the sensor by sweeping through the network and displaying the detected levels at each point on an alphanumeric display on each panel.
- 19.3 The displays will indicate three alarm levels for each sensing point. LED will provide visual feedback in the following manner: (1) Normal operation - Green LED; (2) Alarm level 1 - Red LED; Alarm level 2 - Red LED; Alarm level 3 - Red LED; Failure - Yellow LED. Panel shall have an incorporated audible alarm, rated at no less than 65 dBA at 3 feet, that will be activate at fully programmable levels. All Alarm Levels shall be communicated digitally to the controls system. Coordinate Modbus or BACNet/IP with project requirements and provide as necessary.
- 19.4 Infrared Gas Sensors - Provide VA301IRFS refrigerant sensors, or approved equal. Infrared sensors shall be provided as required by code and powered by the control panel’s low voltage power output. Fully addressable infrared refrigerant sensors shall communicate digitally with control panel. Refrigerant shall be detected by the sensing of the absorption rate of a specific bandwidth of light. The sensors shall have resolution levels of 1 ppm with a minimum range of 0-1000 ppm.
- 19.5 Along with networking capability with the control panel, unit shall also have analog outputs of 0-10 Vdc or 4-20mA for communicating with a BAS/DDC. Unit will be equipped with an impact resistant housing equivalent to a NEMA 12 rating.

| TOXIC GASES | FIRST ALARM SETPOINT (TLV-TWA) | SECOND ALARM SETPOINT | THIRD ALARM SETPOINT | SENSOR LOCATION | RADIUS OF COVERAGE |
|-------------|--------------------------------|-----------------------|----------------------|----------------------|--------------------|
| R-134a | 250 ppm | 500 ppm | 900 ppm | 1 ft above the floor | 23 feet |

- 19.6 Strobe Horn - Strobe horn shall be activated by the Control panel and/or the Annunciator panel. Rating of horn shall be no less than 72dB at 10 feet. Intensity of light shall be no less than 640W and shall flash at a frequency of 1 per second.
- 19.7 Start-up by factory authorized service representative shall be required. System checks and sequence of operation to be verified. Additionally, at end of warranty period, factory authorized representative to recalibrate sensors and transmitters. Written report to be submitted to owner upon conclusion of this work.

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DIVISION

ELECTRICAL

DIVISION 26 – ELECTRICALSECTION 260501 - GENERAL PROVISIONS - ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special, and Supplementary Conditions, and Divisions 00 and 01 Specification Sections, apply to this Section.
- B. The Instructions to Bidders, General and Special Conditions, and all other contract documents shall apply to the Contractor's work as well as to each of his Sub Contractor's work. Each Contractor is directed to familiarize himself in detail with all documents pertinent to this Contract. In case of conflict between these General Provisions and the General and/or Special Conditions, the affected Contractor shall contact the Engineer for clarification and final determination.
- C. Each Contractor shall be governed by any alternates, unit prices and Addenda or other contract documents insofar as they may affect his part of the work.

1.2 SUMMARY

- A. The work included in this division consists of the furnishing of all labor, equipment, transportation, supplies, material and appurtenances and performing all operations necessary for the satisfactory installation of complete and operating Electrical Systems indicated on the drawings and/or specified herein.
- B. Any materials, labor, equipment or services not mentioned specifically herein which may be necessary to complete or perfect any part of the Electrical Systems in a substantial manner, in compliance with the requirements stated, implied, or intended in the drawings and specifications, shall be included as part of this Contract. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten days prior to bid. In the absence of such written notice and by the act of submitting his bid, it shall be understood that the Contractor has included the cost of all required items in his bid, and that he will be responsible for the approved satisfactory functioning of the entire system without extra compensations.
- C. It is not the intent of this Section of the Specifications to make any Contractor, other than the General Contractor, Prime Contractor, Construction Manager responsible to the Owner. All transactions such as submittal of shop drawings, claims for extra costs, requests for equipment or materials substitution, shall be routed through the General Contractor to the Architect, then to the Engineer. Also, this Section of the Specifications shall not be construed as an attempt to arbitrarily assign responsibility of work, material, equipment or services to a particular trade or Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be optional.
- D. This section of the Specifications or the arrangement of the Contract Documents shall not be construed as an attempt to arbitrarily assign responsibility for work, material, equipment or services to a particular trade Contractor or Sub-Contractor. Unless stated otherwise, the subdivision and assignment of work under the various sections shall be the responsibility of the Contractor holding the Prime Contract.
- E. It is the intent of this Contract to deliver to the Owners a "like new" project once work is complete. Although plans and specifications are complete to the extent possible, it shall be responsibility of the Contractors involved to remove and/or relocate or re-attach any existing or new systems which interfere with new equipment or materials to be installed by other trades without additional cost to the Owner.
- F. In general, and to the extent possible, all work shall be accomplished without interruption of the existing facilities' operations. Each Contractor shall advise the Architect, Owner and Engineer in writing at least one week prior to the deliberate interruption of any services. The Owners shall be advised of the exact

time that interruption will occur and the length of time the interruption will occur. Failure to comply with this requirement may result in complete work stoppage by the Contractors involved until a complete schedule of interruptions can be developed. Contractor will not be entitled to additional compensation due to work stoppage mandated by unscheduled interruption.

- G. Whenever utilities are interrupted, either deliberately or accidentally, the Contractor shall work continuously to restore said service. The Contractor shall provide tools, materials, skilled journeymen of his own and other trades as necessary, premium time as needed and coordination with all applicable utilities, including payment of utility company charges (if any), all without requests for extra compensation to the Owner, except where otherwise provided for in the contract for the work. The Contractor shall abide by the requirements of the Special Conditions and the Owner's outage request program.
- H. Required Notices: Ten days prior to the submission of a proposal, each proposer shall give written notice to the Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, Proposers signify that they have included the cost of all required items in the proposal and that the Proposer will be responsible for the safe and satisfactory operation of the entire system.
- I. Any reference within these specifications to a specific entity, i.e., "Electrical Contractor" is not to be construed as an attempt to limit or define the scope of work for that entity or assign work to a specific trade or contracting entity. Such assignments of responsibility are the responsibility of the Contractor or Construction Manager holding the prime contract, unless otherwise provided herein.
- J. In each of the specifications and drawings referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.3 DEFINITIONS AND ABBREVIATIONS

- A. Prime Contractor - The Contractor who has been engaged by the Owner in a contractual relationship to accomplish the work.
- B. Contractor - Any Contractor whether bidding, proposing or working independently or under the supervision of a General Contractor, Prime Contractor, Construction Manager and who installs any type of Electrical Work as specified in the Contract Documents.
- C. Electrical Contractor - Any Contractor whether bidding or working independently or under the supervision of a General Contractor, that is: the one holding the Prime Contract and who installs any type of Electrical work, such as: power, lighting, television, telecommunications, data, fiber optic, intercom, fire detection and alarm, security, video, underground or overhead electrical, etc.
- D. Electrical Sub-Contractor - Each or any Contractor contracted to, or employed by, the Electrical Contractor for any work required by the Electrical Contractor.
- E. Engineer - The Consulting Mechanical-Electrical Engineer either consulting to the Owner, Architect, or Other, etc. In this case: CMTA, Inc., Consulting Engineers.
- F. Architect - The Architect of Record for the project.
- G. Contract Documents - All documents pertinent to the quality and quantity of work to be performed on this project. Includes, but not limited to: Plans, Specifications, Instructions to Bidders, General and Special Conditions, Addenda, Alternates, Lists of Materials, Lists of Sub-Contractors, Unit Prices, Shop Drawings, Field Orders, Change Orders, Cost Breakdowns, Schedules of Value, Periodical Payment Requests, Construction Manager's Assignments, Architect's Supplemental Instructions, Construction Contract with Owner, etc.

- H. Bidder/Proposer - Any person, agency or entity submitting a proposal to any person, agency or entity for any part of the work required under this contract.
- I. The Project - All of the work required under this Contract.
- J. Furnish - Deliver to the site in good condition and turn over to the Contractor who is to install.
- K. Provide - Furnish and install complete, tested and ready for operation.
- L. Install - Install equipment furnished by others in complete working order.
- M. Indicated - Listed in the Specifications, shown on the Plans or Addenda thereto.
- N. Basis of Design (BOD): Documentation of primary thought processes and assumptions behind design decisions made to meet design intent. Describes systems, components, conditions and methods chosen to meet intent.
- O. Monitoring: Recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or trending capabilities of control systems.
- P. Start-up: The activities where systems or equipment are initially tested and operated. Start-up is completed prior to functional testing.
- Q. Vendor: Supplier of equipment.
- R. Typical or Typ- Where indicated repeat this work, method or means each time the same or similar condition occurs whether indicated or not.
- S. Abbreviations:
1. ADA - Americans with Disabilities Act.
 2. AFF – Above Finished Floor
 3. AFG – Above Finished Grade
 4. AIC – Amps Interrupting Capacity
 5. ANSI - American National Standards Institute.
 6. ASA – American Standards Association.
 7. ASTM – American Society for Testing Materials.
 8. ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers.
 9. BAS – Building Automation System.
 10. BICSI – Building Industry Consulting Services International
 11. CM – Construction Manager
 12. EC – Electrical Contractor
 13. EM - Emergency
 14. FCC – United States Federal Communications Commission
 15. FLA – Full Load Amps
 16. GC – General Contractor
 17. IECC – International Energy Conservation Code
 18. IEEE – Institute of Electrical and Electronics Engineers.
 19. IESNA – Illuminating Engineering Society of North America
 20. ISO – International Standards Organization.
 21. LRA – Locked Rotor Amps
 22. MC – Mechanical Contractor
 23. MCA – Minimum Circuit Ampacity
 24. MOCP – Maximum Overcurrent Protection
 25. NEC – National Electrical Code (NFPA 70).
 26. NECA – Standards for Installation.
 27. NEMA - National Electrical Manufacturers Association.
 28. NESC – National Electrical Safety Code.
 29. NFPA - National Fire Protection Association.

- 30. NRTL: Nationally Recognized Testing Laboratory
- 31. N/A – Not Applicable
- 32. OSHA - Office of Safety and Health Administration.
- 33. PC – Plumbing Contractor
- 34. SPD: Surge Protection Device
- 35. TIA – Telecommunications Industry Association
- 36. RFI – Request for Information
- 37. RIO – Rough-in Only
- 38. UL - Underwriters Laboratories, Inc.
- 39. UON – Unless otherwise noted.

1.4 SYSTEM COMMISSIONING

- A. Section 019113 requires the engagement of a Commissioning Authority to document the completion of the Mechanical, Fire Protection, Plumbing, Electrical, Electronic Safety and Security, and associated Control Systems for the project. Section 019113 defines the roles and responsibilities of each member of the commissioning team.
- B. Comply with the requirements of Section 019113 for the commissioning of the various building systems.

1.5 INTENT AND INTERPRETATION

- A. It is the intent of these specifications and all associated drawings that the Contractor provide finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete, tested and ready for operation."
- B. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.
- C. It is the intention of the Contract Documents to call for a complete and operational system, including all components, accessories, finish work, etc. as necessary for trouble free operation; tested and ready for operation. Anything that may be required, implied, or inferred by the Contract Documents shall be provided and included as part of the Bid.
- D. All Contractors and Vendors providing a bid for this project shall review the Plans and Specifications and determine any modifications and/or adjustments necessary relative to the proposed equipment and materials with specific manufacturer's installation requirements. Include in the bid any necessary installation methods, features, options, accessories, etc. necessary to install the proposed equipment and materials, regardless of whether used as basis of design or being offered as a substitution in accordance with the specific manufacturer's installation requirements whether specifically detailed or not within the Plans and Specifications.
- E. Details not usually shown or specified, but necessary for the proper installation and operation of systems, equipment, materials, etc., shall be included in the work, the same as if herein specified or indicated.
- F. The Bidder/Proposer shall completely review the Contract Documents. Any interpretation as to design intent or scope shall be provided by the Engineer / Architect. Should an interpretation be required, the Bidder/Proposer shall request a clarification not less than ten (10) days prior to the submission of the proposal so that the condition may be clarified by Addendum. In the event of any conflict, discrepancy, or inconsistency develops; the interpretation of the Engineer shall be final.
- G. The Contractor shall give written notice of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted a minimum of ten (10) days prior to bid. In the absence of such written notice and by the act of submitting a bid, it shall be understood that the Contractor has included the cost of all required items in the bid, and that will be responsible for the approved satisfactory functioning of the entire system without extra compensations.

1.6 ELECTRICAL DRAWINGS AND SPECIFICATIONS

- A. The drawings are diagrammatic only and indicate the general arrangement of the systems and are to be followed insofar as possible. If deviations from the layouts are necessitated by field conditions, detailed layouts of the proposed departures shall be submitted in writing to the Engineer for approval before proceeding with the work. The Contract Drawings are not intended to show every vertical or horizontal offset which may be necessary to complete the systems. Contractors shall, however, anticipate that additional offsets may be required and submit their bid accordingly.
- B. The drawings and specifications are intended to supplement each other. No Contractor, bidder, proposer or supplier shall take advantage of conflict between them, or between parts of either, but should this condition exist, the Contractor or supplier shall request a clarification of the condition at least ten days prior to the submission of bids so that the condition may be clarified by Addendum. In the event that such a condition arises after work is started, the interpretation of the Engineer shall be the determining factor. In all instances, unless modified in writing and agreed upon by all parties thereto, the Contract to accomplish the work shall be binding on the affected Contractor.
- C. The drawings and specifications shall be considered to be cooperative and complimentary and anything appearing in the specifications which may not be indicated on the drawings or conversely, shall be considered as part of the Contract and must be executed the same as though indicated by both.
- D. This Contractor shall make all his own measurements in the field and shall be responsible for correct fitting. He shall coordinate this work with all other branches of work in such a manner as to cause a minimum of conflict or delay.
- E. The Engineer shall reserve the right to make minor adjustments in location of conduit, fixtures, outlets, switches, etc., where he considers such adjustments desirable in the interest of concealing work or presenting a better appearance.
- F. Each Contractor shall evaluate ceiling heights called for on Architectural Plans. Where the location of Electrical equipment may interfere with ceiling heights, the Contractor shall call this to the attention of the Engineer in writing prior to making the installation. Any such changes shall be anticipated and requested sufficiently in advance so as to not cause extra work on the part of the Contractor or unduly delay the work.
- G. Should overlap of work between the various trades become evident, this shall be called to the attention of the Engineer. In such an event, neither trade shall assume that he is to be relieved of the work which is specified under his branch until instructions in writing are received from the Engineer.
- H. The Electrical drawings are intended to show the approximate location of equipment, materials, etc. Dimensions given in figures on the drawings shall take precedence over scaled dimensions and all dimensions whether given in figures or scaled shall be verified in the field. In case of conflict between small and large scale drawings, the larger scale drawings shall take precedence.
- I. The Electrical Contractor and his Sub-Contractors shall review all drawings in detail as they may relate to his work (structural, architectural, site survey, mechanical, etc.). Review all drawings for general coordination of work, responsibilities, ceiling clearances, wall penetration points, chase access, fixture elevations, etc. Make any pertinent coordination or apparent conflict comments to the Engineers at least ten (10) days prior to bids, for issuance of clarification by written addendum.
- J. Where on any of the drawings a portion of the work is drawn out and the remainder is indicated in outline, or not indicated at all, the parts drawn out shall apply to all other like portions of the work. Where ornament or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts of the work, unless otherwise indicated.
- K. Special Note: Always check ceiling heights indicated on Drawings and Schedules and insure that these heights may be maintained after all mechanical and electrical equipment is installed. If a conflict is apparent, notify the Engineer in writing for instructions.

1.7 EXAMINATION OF SITE AND CONDITIONS

- A. Each Contractor shall inform himself of all of the conditions under which the work is to be performed, the site of the work, the structure of the ground, the obstacles that may be encountered, the availability and location of necessary facilities and all relevant matters concerning the work. All Contractors shall carefully examine all Drawings and Specifications and inform themselves of the kind and type of materials to be used throughout the project and which may, in any way, affect the execution of his work.
- B. Each Contractor shall fully acquaint himself with all existing conditions as to ingress and egress, distance of haul from supply points, routes for transportation of materials, facilities and services, availability of temporary or permanent utilities, etc. The Contractor shall include in his work all expenses or disbursements in connection with such matters and conditions. Each Contractor shall verify all work shown on the drawings and conditions at the site, and shall report in writing to the Engineer ten (10) days prior to bid, any apparent omissions or discrepancies in order that clarifications may be issued by written addendum. No allowance is to be made for lack of knowledge concerning such conditions after bids are accepted.
- C. The Electrical Contractor is required to provide coordination drawings, data and collaboration for all aspects of his work in accordance with the general and special conditions – Divisions 20, 21, 22, 23, 25, 26, 27 and 28 and the Construction Manager's procedures.

1.8 EQUIPMENT AND MATERIALS SUBSTITUTIONS OR DEVIATIONS

- A. When any Contractor requests review of substitute materials and/or equipment, and when under an approved formal alternate proposal, it shall be understood and agreed that such substitution, if approved, will be made without additional cost regardless of changes in connections, spacing, service, mounting, etc. In all cases where substitutions affect other trades, the Contractor offering such substitutions shall advise all such Contractors of the change and shall reimburse them for all necessary changes in their work. Any drawings, Specifications, Diagrams, etc., required to describe and coordinate such substitutions or deviations shall be professionally prepared at the responsible Contractor's expense. Special Note: Review of Shop Drawings by the Engineer does not absolve the Contractor of this responsibility.
- B. References in the specifications to any article, device, product, material, fixture, form, or type of construction by name, make, or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. Each Contractor, in such cases, may, at his option, use any article, device, product, material, fixture, form, or type of construction which in the judgment of the Engineer is equivalent to that specified, provided the provisions of Paragraph 5.1 immediately preceding are met. Substitutions shall be submitted to the Engineer a minimum of ten (10) days prior to bid date for approval to bid in written form through addenda or other method selected by the Engineer. If prevailing laws of cities, towns, states or countries are more stringent than these specifications regarding such substitutions, then those laws shall prevail over these requirements.
- C. Wherever any equipment and material is specified exclusively only such items shall be used unless substitution is accepted in writing by the engineers.
- D. Each Contractor shall furnish along with his proposal a list of specified equipment and materials which he proposes to provide. Where several makes are mentioned in the Specifications and the Contractor fails to state which he proposes to furnish, the Engineer shall have the right to choose any of the makes mentioned without change in price.

1.9 SINGLE SOURCE RESPONSIBILITY AND OBSOLETE EQUIPMENT

- A. Except where specifically noted otherwise, all equipment supplied by the Contractor shall be the standard products of a single manufacturer of known reputation and experience in the industry. Only equipment, components and accessories in current production for at least five (5) years beyond the completion date of this system shall be used and installed. Any equipment found to be obsolete or not in future production will be removed and replaced at Contractor's expense. This includes all equipment, materials and labor.

1.10 CODES, RULES, PERMITS, FEES, REGULATIONS, ETC.

- A. The Contractor shall give all necessary notices, obtain and pay for all permits, government sales taxes, fees, and other costs including utility connections or extensions, in connection with his work. As necessary, he shall file all required plans, utility easement requests and drawings, survey information on line locations, load calculations, etc., prepare all documents and obtain all necessary approvals of all utility and governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Engineer before request for acceptance and final payment for the work.
- B. Ignorance of Codes, Rules, regulations, utility company requirements, laws, etc., shall not diminish or absolve Contractor's responsibilities to provide and complete all work in compliance with such.
- C. The Contractor shall include in the work, without extra cost, any labor, materials, services, apparatus or drawings required in order to comply with all applicable laws, ordinances rules and regulations, whether or not shown on drawings and/or specified.
- D. All materials furnished and all work installed shall comply with the current edition of the National Electrical Codes, National Fire Codes of the National Fire Protection Association, the requirements of local utility companies, and with the requirements of all governmental agencies or departments having jurisdiction.
- E. All material and equipment for the electrical systems shall bear the approval label, or shall be listed by the Underwriters' Laboratories, Incorporated. Listings by other testing agencies may be acceptable with written approval by the Engineer.
- F. All electrical work is to be constructed and installed in accordance with plans and specifications which have been approved in their entirety and/or reflect any changes requested by the State Fire Marshal, as applicable or required. Electrical work shall not commence until such plans are in the hands of the Electrical Contractor.
- G. The Contractor shall insure that his work is accomplished in accord with OSHA Standards and any other applicable government requirements.
- H. Where conflict arises between any code and the plans and/or specifications, the code shall apply except in the instance where the plans and specifications exceed the requirements of the code. Any changes required as a result of these conflicts shall be brought to the attention of the Engineer at least ten working days prior to bid date, otherwise the Contractor shall make the required changes at his own expense. The provisions of the codes constitute minimum standards for wiring methods, materials, equipment and construction and compliance therewith will be required for all electrical work, except where the drawings and specifications require better materials, equipment, and construction than these minimum standards, in which case the drawings and specifications shall be the minimum standards.

1.11 SUPERVISION OF WORK

- A. Each Contractor and Sub-Contractors shall personally supervise the work or have a competent superintendent on the project site at all times during progress of the work, with full authority to act for him in matters related to the project.

1.12 COST BREAKDOWNS AND PAY APPLICATION

- A. Within thirty days after acceptance of the Contract, each Contractor is required to furnish to the Engineer one copy of a detailed cost breakdown on each respective area of work. These cost breakdowns shall be made on forms provided or approved by the Engineer or Architect. Payments will not be made until satisfactory cost breakdowns are submitted. Refer to Division 0 and 1 specification sections for additional requirements.
- B. In addition to cost breakdowns by specification section, the following shall also be provided: Material and labor shall be listed separately. These items are in addition to items listed in front-end specifications.

Pay special attention to required withholding percentages for startup, testing, documentation, acceptance, owner training, etc. The breakdown shall be minimally as follows:

1. Permitting
2. Mobilization
3. Electrical Shop Drawings/Submittals
4. Electrical Coordination Drawings
5. Temporary Power
6. Feeders Materials & Labor
7. Branch Circuiting Materials & Labor
8. Service Grounding Materials & Labor
9. Electrical Devices Materials & Labor
10. Ladder/Cable Trays Materials & Labor
11. Fire Alarm Materials & Labor
12. Fire Alarm System Startup, Testing, & Verification (shall equal 5% of Equipment Value)
13. Electrical Distribution Equipment Startup, Testing, & Verification (shall equal 2.5% of Equipment Value)
14. Owner Training & Acceptance
15. Punchlist
16. As-Built/Record Drawings & Acceptance
17. O&M Manuals & Acceptance
18. Warranty
19. Demobilization

1.13 GUARANTEES AND WARRANTIES

- A. Each Contractor shall unconditionally guarantee all equipment, apparatus, materials, and workmanship entering into this Contract to be the best of its respective kind and shall replace all parts at his own expense, which fail or are deemed defective within one year from final acceptance of the work by the Engineer. The effective date of completion of the work shall be the date each or any portion of the work is accepted by the Engineer and Owner's Statement of Substantial Completion.
- B. Items of equipment which have longer guarantees, as called for in these specifications or as otherwise offered by the manufacturer, such as generators, engines, batteries, transformers, etc., shall have warranties and guarantees completed in order, and shall be in effect at the time of final acceptance of the work by the Engineer. The Contractor shall present the Engineer with such warranties and guarantees at the time of final acceptance of the work. The Owner reserves the right to use equipment installed by the Contractor prior to date of final acceptance. Such use of equipment shall in no way invalidate the guarantee except that the Owner shall be liable for any damage to equipment during this period due to negligence of his operator or other employee.
- C. The Warranties specified in this and other Articles shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.
- D. Provide all warranty certificates to Owner. All warranties begin starting at the substantial completion date, submit warranty certificates accordingly.

1.14 INSPECTION, APPROVALS AND TESTS

- A. Before requesting a final review of the installation from the Architect and/or Engineer, the Contractor shall thoroughly inspect his installation to assure that the work is complete in every detail and that all requirements of the Contract Documents have been fulfilled. Failure to accomplish this may result in charges from the Architect and/or Engineers for unnecessary and undue work on their part.

- B. Owner's and Engineer's inspections: Two (2) inspections will be held to generate and then review punchlist items. All site inspections and visits thereafter shall be billed to the Contractor at the Engineer's standard hourly rates.
 - C. The Contractor shall provide as a part of this contract electrical inspection by a competent Electrical Inspection Agency, licensed to provide such services. The name of this agency shall be included in the list of materials of the Form of Proposal by the Contractor. All costs incidental to the provision of electrical inspections shall be borne by the Electrical Contractor.
 - D. The Contractor shall advise each Inspection Agency in writing (with an information copy of the correspondence to the Architect and/or Engineer) when he anticipates commencing work. Failure of the Inspection Agency to inspect the work in the stage following and submit the related reports may result in the Contractor's having to expose concealed work not so inspected. Such exposure will be at the expense of the responsible Contractor.
 - E. Inspections shall be scheduled for rough as well as finished work. The rough inspections shall be divided into as many inspections as may be necessary to cover all roughing-in without fail. Report of each such inspection visit shall be submitted to the Architect, Engineer and the Contractor within three days of the inspection.
 - F. Approval by an Inspector does not relieve the Contractor from the responsibilities of furnishing equipment having a quality of performance equivalent to the requirements set forth in these plans and specifications. All work under this contract is subject to the review of the Architect and/or Engineer, whose decision is binding.
 - G. Before final acceptance, the Contractor shall furnish three (3) copies of the certificates of final approval by the Electrical Inspector (as well as all other inspection certificates) to the Engineer with one (1) copy of each to the appropriate government agencies, as applicable. Final payment for the work shall be contingent upon completion of this requirement.
 - H. The Contractor shall test all wiring and connections for continuity and grounds before equipment and fixtures are connected, and when indicated or required, demonstrate by Megger Test the insulation resistance of any circuit or group of circuits. Where such tests indicate the possibility of faulty insulation, locate the point of such fault, pull out the defective conductor, replacing same with new and demonstrate by further test the elimination of such defect.
- 1.15 CHANGES IN ELECTRICAL WORK
- A. REFER TO GENERAL AND SPECIAL CONDITIONS.
- 1.16 CLAIMS FOR EXTRA COST
- A. REFER TO GENERAL AND SPECIAL CONDITIONS.
- 1.17 SURVEYS, MEASUREMENTS AND GRADES
- A. The Contractor shall lay out his work and be responsible for all necessary lines, levels, elevations and measurements. He must verify the figures shown on the drawings before laying out the work and will be held responsible for any error resulting from his failure to do so.
 - B. The Contractor shall base all measurements, both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.
 - C. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, he shall notify the Engineer thru normal channels of job communication and shall not proceed with his work until he has received instructions from the Engineer.
- 1.18 UTILITY COMPANY REQUIREMENTS

- A. The Contractor shall provide the local utility company with a drawing produced by a licensed Land Surveyor or a licensed Engineer in the State of Indiana and acceptable to the utility that locates the centerline of the primary duct. Coordinate further requirements with utility company.
- B. Contact the utility company for specifics on construction of pads, conduit, etc., prior to bidding the work and determine all their requirements. All work shall be in accordance with their standards.
- C. The Electrical Contractor is responsible for all fees, permit costs, etc., from the electrical utility, data, telephone and cable TV companies. This includes any cost associated with the underground electrical service extension.
- D. Each contractor, prior to bidding the work, is to contact the utility companies (electric, data, telephone and cable TV) and determine the exact points of extension of all underground services in the field with a representative of each utility company. Also, obtain construction details on manholes, transformer pads, pedestal stub-ups, etc., from each utility company as applicable. Extension points indicated on the plans are approximate, and are given for the bidder's information only.

1.19 TEMPORARY SERVICES

- A. The Contractor shall arrange for temporary electrical and other services which he may require to accomplish his work. In the absence of other provisions in the contract, the Contractor shall provide for his own temporary services of all types, including the cost of connections, utility company fees, construction, removal, etc., in his bid.
- B. All temporary services shall be removed by Contractor prior to acceptance of work.

1.20 TEMPORARY USE OF EQUIPMENT

- A. The permanent electrical equipment, (except lighting), when installed, may be used for temporary services, subject to an agreement among the Contractors involved, the Owner, and with the consent of the Engineer. Should the permanent systems be used for this purpose, each Contractor shall pay for all temporary connections required and any replacements required due to damage without cost, leaving the equipment and installation in "as new" condition. The Contractor may be required to bear utility costs, user fees, etc.
- B. Permission to use the permanent equipment does not relieve the Contractors who utilize this equipment from the responsibility for any damages to the building construction and/or equipment which might result because of its use.

1.21 MATERIALS AND WORKMANSHIP

- A. All electrical equipment, materials and articles incorporated in the work shall be new and of comparable quality to that specified. All workmanship shall be first-class and shall be performed by electricians skilled and regularly employed in their respective trades. The Contractor shall determine that the equipment he proposes to furnish can be brought into the building(s) and installed within the space available. All equipment shall be installed so that all parts are readily accessible for inspection, maintenance, replacement, etc. Extra compensation will not be allowed for relocation of equipment for accessibility or for dismantling equipment to obtain entrance into the building(s).
- B. All conduit and/or conductors shall be concealed in or below walls, below floors or above ceilings, unless otherwise noted. All fixtures, devices and wiring required shall be installed to make up complete systems as indicated on the drawings and specified herein. Raceways shall not be placed within foundation walls and footings.
- C. All materials, where applicable, shall bear Underwriters' Laboratories label or that of another Engineer approved testing agency, where such a standard has been established.
- D. Each length of conduit, wireway, duct, conductor, cable, fitting, fixture and device used in the electrical systems shall be stamped or indelibly marked with the maker's mark or name.

- E. All electrical equipment shall bear the manufacturer's name and address and shall indicate its electrical capacity and characteristics.
- F. All electrical materials, equipment and appliances shall conform to the latest standards of the National Electric Manufacturers Association (NEMA) and the National Board of Fire Underwriters (NBFU) and shall be approved by the Owner's insuring agency if so required.
- G. Comply with National Electrical Contractors Association (NECA) performance standards that are published as National Electrical Installation Standards (NEIS).
- H. All applicable equipment and devices provided shall meet all FCC requirements and restrictions.

1.22 QUALIFICATIONS OF WORKMEN

- A. All Electrical Contractors bidding this project must have been a licensed company for a minimum of three (3) years to qualify to bid this project. Individual employee experience does not supersede this requirement.
- B. All subcontractors bidding the electrical work must have completed one project of 70% this subcontract cost size and two projects of 50% this subcontract cost size.
- C. All electrical work shall be accomplished by qualified workmen competent in the area of work for which they are responsible. Untrained and incompetent workmen as evidenced by their workmanship shall be relieved of their responsibilities in those areas. The Engineer shall reserve the right to determine the quality of workmanship of any workman and unqualified or incompetent workmen shall refrain from work in areas not satisfactory to him. Requests for relief of a workman shall be made through the normal channels of responsibility established by the Architect or the contract document provisions.
- D. All electrical work shall be accomplished by Journeymen electricians under the direct supervision of a licensed Electrician. All applicable codes, utility company regulations, laws and permitting authority of the locality shall be fully complied with by the Contractor.
- E. Special electrical systems, such as Fire Detection and Alarm Systems, Telecommunications or Data Systems, Video Systems, Special Electronic Systems, Control Systems, etc., shall be installed by workmen normally engaged or employed in these respective trades.

1.23 CONDUCT OF WORKMEN

- A. The Contractor shall be responsible for the conduct of all workmen under his supervision. Misconduct on the part of any workmen to the extent of creating a safety hazard, or endangering the lives and property of others, shall result in the prompt relief of that workman. The consumption or influence of alcoholic beverages, narcotics or illegally used controlled substances on the jobsite is strictly forbidden.

1.24 COOPERATION AND COORDINATION BETWEEN TRADES

- A. The Contractor is expressly directed to read the General Conditions and all detailed sections of these specifications for all other trades and to study all drawings applicable to his work, including Architectural, Mechanical, Structural and other pertinent Drawings, to the end that complete coordination between trades will be effected.
- B. Refer to Coordination Among Trades, Systems Interfacing and Connection of Equipment Furnished by Others section of these Specifications for further coordination requirements. The Contractor is responsible for the correct location of all rough-in and connections at every piece of equipment. Work not correctly located shall be relocated at the Contractor's expense.
- C. Where any work is to be installed in close proximity to, or will interfere with work of other trades, each shall cooperate in working out space conditions to make a satisfactory adjustment. If so directed by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than $\frac{1}{4}'' = 1'-0''$, clearly indicating how his work is to be installed in relation to the work of other

trades, or so as not to cause any interference with work of other trades. He shall make the necessary changes in his work to correct the condition without extra charge.

- D. The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

1.25 PROTECTION OF EQUIPMENT

- A. The Contractor shall be entirely responsible for all material and equipment furnished by him in connection with his work and special care shall be taken to properly protect all parts thereof from damage during the construction period. Such protection shall be by a means acceptable to the Engineer. All rough-in conduit shall be properly plugged or capped during construction in a manner approved by the Engineer. Equipment damaged while stored on site either before or after installation shall be repaired or replaced (as determined by the Engineer) by the responsible Contractor. Electrical equipment exposed to the weather shall be replaced by the Contractor at his expense.

1.26 SCAFFOLDING, RIGGING AND HOISTING

- A. The Contractor shall furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished. All such temporary appurtenances shall be set up in strict accord with OSHA Standards and Requirements. Remove same from premises when no longer required.

1.27 CONCRETE WORK

- A. The Contractor shall be responsible for the provision of all concrete work required for the installation of any of his systems or equipment. If this work is provided by another trade, it will not relieve the Electrical Contractor of his responsibilities relative to dimensions, quality of workmanship, locations, etc. In the absence of other concrete specifications, all concrete related to Electrical work shall be 3000 PSI minimum compression strength at 28 days curing and shall conform to the standards of the American Concrete Institute Publication ACI-318. Heavy equipment shall not be set on pads for at least seven days after pour.
- B. All concrete pads shall be complete with all pipe sleeves, embeds, anchor bolts, reinforcing steel, concrete, etc., as required. Pads larger than 18" in width shall be reinforced with minimum #4 round bars on 6" centers both ways. All reinforcing steel shall be per ASTM requirements, tied properly, lapped 18 bar diameters and supported appropriately up off form, slab or underlayment. Bars shall be approximately 3" above the bottom of the pad with a minimum 2" cover. All parts of pads and foundations shall be properly rodded or vibrated. If exposed parts of the pads and foundations are rough or show honeycomb after removing forms properly adhered repairs shall be made. If structural integrity is violated, the concrete shall be replaced. All surfaces shall be rubbed to a smooth finish.
- C. Special Note: All pads and concrete lighting standard bases shall be crowned slightly so as to avoid water ponding beneath equipment.
- D. In general, concrete pads for small equipment shall extend 6" beyond the equipment's base dimensions. For large equipment with service access panels, extend pads 18" beyond base or overall dimensions to allow walking and servicing space at locations requiring service access.
- E. Exterior concrete pads shall be 4" minimum above grade and 4" below grade on a tamped 4" dense grade rock base unless otherwise noted or required by utility company. Surfaces of all foundations and bases shall have a smooth finish with three-quarter inch radius or chamfer on exposed edges, troweled or rubbed smooth. All exterior pads shall be crowned approximately 1/8" per foot, sloping from center for drainage.

1.28 SMOKE AND FIRE PROOFING

- A. The Contractor shall not penetrate rated fire walls, ceilings or floors with conduit, cable, bus duct, wireway or other raceway system unless all penetrations are protected in a code compliant manner which

maintains the rating of the assembly. Smoke and fire stop all openings made in walls, chases, ceiling and floors. Patch all openings around conduit, wireway, bus duct, etc., with appropriate type material to smoke stop walls and provide needed fire rating at fire walls, ceilings and floors. Smoke and fire proofing materials and method of application shall be approved by the local authority having jurisdiction. Refer to architectural plans and specifications for further requirements.

- B. Contractor to provide heat detectors in the area of construction with complete fire detection until fire alarm system is operational and construction is complete.
- C. Fire-stopping materials and installation shall be by a single source through-out the project, by all trades.
- D. All fire-stopping assemblies must be UL listed. Provide shop drawings indicating penetration detail for each type of wall and floor construction. Shop drawings must be specific for each individual type (i.e., one-hour fire rated gypsum wall board with insulated metal pipe penetration.) and must indicate a UL listing for the complete fire-stopping assembly.
- E. 3M fire protection products are listed below. Equivalent products may be submitted if they are UL listed.
- F. All of the fire-stopping shall be applied by a Contractor who is certified by the manufacturer of the fire-stopping product for installation of the product.
- G. Fire-stopping materials to include but not limited to the following:
 - 1. 3M fire barrier FS-195 wrap/strip.
 - 2. 3M fire barrier CP 25 caulk.
 - 3. 3M fire barrier MP moldable putty.
 - 4. 3M fire barrier RC-1 restricting collar with steel hose clamp.
 - 5. 3M fire barrier damming materials.
 - 6. 3M fire barrier CS-195 composite sheet.
 - 7. 3M fire barrier fire dam 150 caulk.
 - 8. Steel sleeves.
 - 9. Hilti Speed Sleeves.

1.29 QUIET OPERATION, SUPPORTS, VIBRATION AND OSCILLATION

- A. All work shall operate under all conditions of load without any objectionable sound or vibration, the performance of which shall be determined by the Engineer. Noise from moving machinery or vibration noticeable outside of room in which it is installed, or annoyingly noticeable noise or vibration inside such room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Engineer shall be corrected in an approved manner by the Contractor (or Contractors responsible) at his expense.
- B. All equipment subject to vibration and/or oscillation shall be mounted on vibration supports suitable for the purpose of minimizing noise and vibration transmission, and shall be isolated from external connections such as piping, ducts, etc., by means of flexible connectors, vibration absorbers or other approved means. Surface mounted equipment such as panels, switches, etc., shall be affixed tightly to their mounting surface.
- C. The Contractor shall provide supports for all equipment furnished by him using an approved vibration isolating type as needed. Supports shall be liberally sized and adequate to carry the load of the equipment and the loads of attached equipment, piping, etc. All equipment shall be securely fastened to the structure either directly or indirectly through supporting members by means of bolts or equally effective means. No work shall depend on the supports or work of unrelated trades unless specifically authorized in writing by the Architect or Engineer.

1.30 WELDING

- A. The Contractor shall be responsible for quality of welding done by his organization and shall repair or replace any work not done in accordance with the Architect's or structural Engineer's specifications for

such work. If required by the Engineer, the responsible Contractor shall cut at least three welds during the job for X-raying and testing. These welds are to be selected at random and shall be tested as a part of the responsible Contractor's work. Certification of these tests and X-rays shall be submitted, in triplicate, to the Engineer. In case a faulty weld is discovered, the Contractor shall be required to furnish additional tests and corrective measures until satisfactory results are obtained.

1.31 ACCESSIBILITY

- A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, the adequate clearance in partitions and above suspended ceilings for the proper installation of his work. He shall cooperate with the General Contractor (or Construction Manager) and all other Contractors whose work is in the same space, and shall advise each Contractor of his requirements. Such spaces and clearances shall be kept to the minimum size required to ensure adequate clearance and access.
- B. The Contractor shall locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include but not be limited to junction boxes, pull boxes, contactors, panels, disconnects, controllers, switchgear, etc. Minor deviations from drawings may be made to allow for better accessibility, and any change shall be approved where the equipment is concealed.
- C. Each Contractor shall provide (or arrange for the provision by other trades) the access panels for each concealed junction box, pull box, fixtures or electrical device requiring access or service as shown on Engineer's plans or as required. Locations of these panels shall be identified in sufficient time to be installed in the normal course of work. All access panels shall be installed in accord with the Architect's standards for such work. In the absence of such specifications, at a minimum such work shall comply with the specifications below. All locations for access panels which are not specifically indicated on the drawings shall be submitted to and approved by the architect prior to ordering.
- D. Access Doors; in Ceilings or Walls:
 - 1. In mechanical, electrical and service spaces: 14-gauge aluminum brushed satin finish, 1" border.
 - 2. In finished areas: 14-gauge primed steel with 1" border to accept the architectural finishes specified for the space. Confirm these provisions with the Architect prior to obtaining materials or installing any such work.
 - 3. In fire or smoke rated partitions, access doors shall be provided that equal or exceed the required rating of the construction they are mounted in.

1.32 RESTORATION OF NEW OR EXISTING SHRUBS, PAVING, ETC.

- A. The Contractor shall replace to their original condition all paving, curbing surfaces, drainage ditches, structures, fences, shrubs, existing or new building surfaces and appurtenances, and any other items damaged or removed by his operations. Replacement and repairs shall be in accordance with good construction practice and shall match materials employed in the original construction of the item to be replaced. All repairs shall be to the satisfaction of the Engineer, and in accord with the Architect's standards for such work, as applicable. Patchwork on new construction will not be accepted.

1.33 MAINTENANCE OF EXISTING UTILITIES AND LINES

- A. The locations of all piping, conduits, cables, utilities and manholes existing, or otherwise, that come within the contract construction site, shall be subject to continuous uninterrupted maintenance with no exception unless the Owner of the utilities grants permission to interrupt same temporarily, if need be. Provide one week's written notice to Engineer, Architect and Owner prior to interrupting any utility service or line. Also see Paragraph 1.2 - SUMMARY, of this specification.
- B. Known utilities and lines as available to the Engineer are shown on the drawings. However, it is additionally required that, prior to any excavation being performed, each Contractor ascertain and mark all utilities or lines that would be endangered by the excavation. Contractor shall bear costs of repairing damaged utilities.

- C. If the above mentioned utilities or lines occur in the earth within the construction site, the Contractor shall first probe and make every effort to locate the lines prior to excavating in the respective area.
 - D. Cutting into existing utilities and services shall be done in coordination with and as designated by the Owner of the utility. The Contractor shall work continuously to restore service(s) upon deliberate or accidental interruption, providing premium time and materials as needed without extra claim to the Owner.
 - E. The Contractor shall repair to the satisfaction of the Engineer any surface or subsurface improvements damaged during the course of the work, unless such improvement is shown to be abandoned or removed.
 - F. Machine excavation shall not be permitted within ten feet of existing gas or fuel lines. Hand excavate only in these areas, in accord with utility company, agency or other applicable laws, standards or regulations.
 - G. Protect all new or existing lines from damage by traffic, etc. during construction.
 - H. Protect existing trees, indicated to remain with fencing or other approved method. Hold all new subsurface lines outside the drip line of trees, offsetting as necessary to protect root structures. Refer to planting or landscaping plans, or in their absence, consult with the Architect.
- 1.34 MANUFACTURER'S NAMEPLATE
- A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
- 1.35 ELECTRICAL CONNECTIONS
- A. The Contractor shall furnish and install all power wiring complete from power source to motor or equipment junction box, including power wiring through starters. The Contractor shall install all starters not factory mounted on equipment. Unless otherwise noted, the supplier of equipment shall furnish starters with the equipment. Also, refer to Division 20, 21, 22, 23, 24, 25, 26, 27, and 28 of Specifications, shop drawings and equipment schedules for additional information and requirements.
 - B. All control, interlock, sensor, thermocouple and other wiring required for equipment operation shall be provided by the Contractor. All such installations shall be fully compliant with all requirements of Division 26, 27 and 28 regardless of which trade actually installs such wiring. Motors and equipment shall be provided for current and voltage characteristics as indicated or required. All wiring shall be enclosed in raceways unless otherwise noted.
 - C. Each Contractor or Sub-Contractor, prior to bidding the work, shall coordinate power, control, sensor, interlock and all other wiring requirements for equipment or motors with all other contractors or sub-contractors, to ensure all needed wiring is provided in the Contract. Failure to make such coordination shall not be justification for claims of extra cost or a time extension to the Contract.
- 1.36 FINAL CONNECTIONS TO EQUIPMENT
- A. The roughing-in and final connections to all electrically operated equipment furnished under this and all other sections of the contract documents or by others, shall be included in the Contract and shall consist of furnishing all labor and materials for connection. The Contractor shall carefully coordinate with equipment suppliers, manufacturer's representatives, the vendor or other trades to provide complete electrical and dimensional interface to all such equipment (kitchen, hoods, mechanical equipment, panels, refrigeration equipment, etc.).
- 1.37 ENERGIZED EQUIPMENT
- A. At no time shall the contractor work on energized electrical equipment. Contractor shall comply with NFPA 70E requirements at all times throughout construction.
- 1.38 MOTORS

- A. Each motor shall be provided by the equipment supplier, installer or manufacturer with conduit terminal box and NEC required disconnecting means as indicated or required. Three-phase motors shall be provided with external thermal overload protection in their starter units. Single-phase motors shall be provided with thermal overload protection, integral to their windings or external, in control unit. All motors shall be installed with NEMA-rated starters as specified and shall be connected per the National Electrical Code.
- B. The capacity of each motor shall be sufficient to operate associated driven devices under all conditions of operation and load and without overload, and at least of the horsepower indicated or specified. Each motor shall be selected for quiet operation, maximum efficiency and lowest starting KVA per horsepower as applicable. Motors producing excessive noise or vibration shall be replaced by the responsible contractor. Refer to Division 20, 21, 22, 23 and 25 of the Specifications for further requirements and scheduled sizes.
- C. All three-phase motors shall be tested for proper rotation. Correct wiring if needed and retest. Document testing and corrective action in operations and maintenance manual.

1.39 CUTTING AND PATCHING

- A. Unless otherwise indicated or specified, the Contractor shall provide cutting and patching necessary to install the work specified in this Division. Patching shall match adjacent surfaces to the satisfaction of the Engineer and shall be in accord with the Architect's standards for such work, as applicable.
- B. No structural members shall be cut without the approval of the Structural Engineer and all such cutting shall be done in a manner directed by him.

1.40 SLEEVES AND PLATES

- A. Each Contractor shall provide and locate all sleeves and inserts required for his work before the floors and walls are built, or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed, or where incorrectly located. Each Contractor shall do all drilling required for the installation of his hangers. Drilling of anchor holes may be prohibited in post-tensioned concrete construction, in which case the Contractor shall request approved methods from the Architect and shall carefully coordinate setting of inserts, etc., with the Structural Engineer and/or Architect.
- B. Sleeves shall be provided for all electrical conduit passing thru concrete floor slabs and concrete, masonry, tile and gypsum wall construction. Sleeves shall not be provided for piping running embedded in concrete or insulating concrete slabs on grade, unless otherwise noted.
- C. Where sleeves are placed in exterior walls below grade, the space between the pipe or conduit and the sleeves shall be packed with oakum and lead, mechanical water stop or other approved material and made completely water tight by a method approved by the Engineer and/or Architect.
- D. Where conduit motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Check floor and wall construction finishes to determine proper length of sleeves for various locations; make actual lengths to suit the following:
 - 1. Terminate sleeves flush with walls, partitions and ceiling.
 - 2. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
 - 3. In all areas where pipes are exposed, extend sleeves 1/2 inch above finished floor, except in rooms having floor drains, where sleeves shall be extended 3/4 inches above floor.
- E. Sleeves shall be constructed of 24-gauge galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated on the drawings.
- F. Fasten sleeves securely in floors, walls, so that they will not become displaced when concrete is poured or when other construction occurs around them. Take precautions to prevent concrete, plaster or other

materials being forced into the space between pipe and sleeve during construction. Fire and smoke stop all sleeves in a manner approved by the local authority having jurisdiction or per prevailing codes.

1.41 ANCHORS

- A. Each Contractor shall provide and locate all inserts required for his work before the floors and walls are built, or shall be responsible for the cost of cutting and patching required where inserts were not installed, or where incorrectly located. Each Contractor shall do all drilling required for the installation of his hangers. Drilling of anchor holes may be prohibited in post-tensioned concrete construction, in which case the Contractor shall request approved methods from the Architect and shall carefully coordinate setting of inserts, etc., with the Structural Engineer and/or Architect.

1.42 CONDUIT MOUNTING HEIGHTS

- A. All exposed or concealed conduit, raceways, etc., shall be held as high as possible unless otherwise noted and coordinated with all other trades. Exposed conduit shall, insofar as possible, run perpendicular or parallel to the building structure.

1.43 PAINTING

- A. Each fixture device, panel, junction box, etc., that is located in a finished area shall be provided with finish of color and type as selected or approved by the Architect or Engineer. If custom color is required, it shall be provided at no additional cost to the Owner. All other equipment, fixtures or devices located in finished or unfinished areas, that are not required to have or are provided with finish color or coating shall be provided in a prime painted condition, ready to receive finish paint or coating. All galvanized metal in finished areas shall be properly prepared with special processes to receive finish paint as directed and approved by the Architect.

1.44 WEATHERPROOFING

- A. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the Architect and/or Engineer before work is done. The Contractor shall furnish all necessary sleeves, caulking and flashing required to make openings absolutely watertight.
- B. Wherever work penetrates roofing, it shall be done in a manner that will not diminish or void the roofing guarantee or warranty in any way. Coordinate all such work with the roofing installer.

1.45 EQUIPMENT/CONTROLS STARTUP & VERIFICATION

- A. A pre-start-up conference shall be held with the Engineer, Owner, Construction Manager, General Contractor, Mechanical Contractor, Electrical Contractor, Controls Contractor, Test and Balance Contractor, and any manufacturer's providing startup services. The purpose of this meeting will be to discuss the goals, procedures, etc. for start-up
- B. Equipment and controls startup and verification shall be required for this project. A specific line-item shall be included on the schedule of values by each Trade for "equipment and controls startup". This line-item value shall be approved by the Engineer. The Engineer, Owner and the Engineer's Field Inspectors shall closely monitor progress and quality of the equipment and controls startup and may withhold pay requests as deemed appropriate.
- C. The Contractor shall include in the bid to provide equipment and controls startup and verification for ALL Electrical systems specified for this project. Specific startup/verification specifications are included throughout the Electrical specifications. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians (not third party contractors) and shall complete and submit start-up reports/checklists. Submit factory start-up reports to the Engineer. The contractor shall have appropriate trades on site to correct all deficiencies noted by the factory representative. For each deficiency noted, documentation of corrective action (including date and time) shall be submitted to the Engineer and Owner.

- D. Many pieces of equipment and systems are specified with “manufacturer” startup. In general, the manufacturer’s recommended startup procedures and checklists will be acceptable for use in the project. Where “manufacturer” startup is not specified, then this Contractor shall perform startup services in strict accordance with manufacturer’s instructions. All startup/verification process shall be thoroughly documented by the Contractor and shall include the time and date when performed.
- E. The Contractor shall be responsible for completion of their own System Verification Checklist (SVC) / Manufacturer’s Checklists. Furnish to the Testing Agent and Engineer. Sample checklists shall be submitted to the Engineer, Owner, and Testing Agent for approval.

1.46 OPERATING INSTRUCTIONS

- A. Upon completion of all work and all tests, each Contractor shall furnish the necessary skilled labor and helpers for operating his systems and equipment for a period of three days of eight hours each, or as otherwise specified. During this period, instruct the Owner or his representative fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least one week's written notice to the Owner, Architect and Engineer in advance of this period. The Engineer may attend any such training sessions or operational demonstrations. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representative that were present.
- B. Unless specified otherwise in Division 1, each Contractor shall furnish three (3) complete bound sets for approval to the Engineer of typewritten and/or blueprinted instructions for operating and maintaining all systems and equipment included in this contract. All instructions shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
- C. Unless specified otherwise in Division 1, each Contractor, in the above mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.

1.47 CLEANING

- A. The Contractor shall, at all times, keep the area of his work presentable to the public and clean of rubbish caused by his operations; and at the completion of the work, shall remove all rubbish, all of his tools, equipment, temporary work and surplus materials, from and about the premises, and shall leave the work clean and ready for use. If the Contractor does not attend to such cleaning immediately upon request, the Engineer may cause cleaning to be done by others and charge the cost of same to the responsible Contractor. Each Contractor shall be responsible for all damage from fire which originates in, or is propagated by, accumulations of his rubbish or debris.
- B. After completion of all work and before final acceptance of the work, each Contractor shall thoroughly clean all equipment and materials and shall remove all foreign matter such as grease, dirt, plaster, labels, stickers, etc., from the exterior of materials, equipment and all associated fabrication. Pay particular attention to finished area surfaces such as lighting fixture lenses, lamps, reflectors, panels, etc.

1.48 INDEMNIFICATION

- A. The Contractor shall hold harmless and indemnify the Engineer, employees, officers, agents and consultants from all claims, loss, damage, actions, causes of actions, expense and/or liability resulting from, brought for, or on account of any personal injury or property damage received or sustained by any person, persons, (including third parties), or any property growing out of, occurring, or attributable to any work performed under or related to this contract, resulting in whole or in part from the negligence of the Contractor, any subcontractor, any employee, agent or representative.

1.49 HAZARDOUS MATERIALS

- A. The Contractor is hereby advised that it is possible that asbestos and/or other hazardous materials are or were present in this building(s). Any worker, occupant, visitor, inspector, etc., who encounters any

material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of his work, insure that his workers are aware of this potential and what they are to do in the event of suspicion. He shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall insure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.

- B. Any worker, occupant, visitor, inspector, etc., who encounters any material of whose content they are not certain shall promptly report the existence and location of that material to the Contractor and/or Owner. The Contractor shall, as a part of their work, insure that their workers are aware of this potential and what they are to do in the event of suspicion. The Contractor shall also keep uninformed persons from the premises during construction. Furthermore, the Contractor shall insure that no one comes near to or in contact with any such material or fumes therefrom until its content can be ascertained to be non-hazardous.
- C. CMTA, Inc., Consulting Engineers, have no expertise in the determination of the presence of hazardous materials. Therefore, no attempt has been made by them to identify the existence or location of any such material. Furthermore, CMTA nor any affiliate thereof will neither offer nor make any recommendations relative to the removal, handling or disposal of such material.
- D. If the work interfaces, connects or relates in any way with or to existing components which contain or bear any hazardous material, asbestos being one, then, it shall be the Contractor's sole responsibility to contact the Owner and so advise him immediately.
- E. The Contractor by execution of the contract for any work and/or by the accomplishment of any work thereby agrees to bring no claim relative to hazardous materials for negligence, breach of contract, indemnity, or any other such item against CMTA, its principals, employees, agents or consultants. Also, the Contractor further agrees to defend, indemnify and hold CMTA, its principals, employees, agents and consultants, harmless from any such related claims which may be brought by any subcontractors, suppliers or any other third parties.

1.50 ABOVE-CEILING AND FINAL PUNCH LISTS

- A. The Contractor shall review each area and prepare a punch list for each of the subcontractors, as applicable, for at least two stages of the project.
 - 1. For review of in-wall work that will be concealed by drywall or other materials well before substantial completion.
 - 2. For review of the above-ceiling work that will be concealed by tile or other materials well before substantial completion.
 - 3. For review of all other work as the project nears substantial completion.
- B. When all work from the Contractor's punch list is complete at each of these stages and prior to completing ceiling installations (or at the final punch list stage), the Contractor shall request that the Engineer develop a punch list. This request is to be made in writing two weeks prior to the proposed date. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list and all work prior to the ceilings being installed and at the final punch list review.
- C. After all corrections have been made from the Engineer's punch list, the Contractor shall review and initial off on each item. This signed-off punch list shall be submitted to the Engineer. The Engineer shall return to the site once to review each punch list and all work prior to the ceilings being installed and at the final punch list review.
- D. At the engineer's option, the contractor shall supply digital photographs via email or file-share of any installed work.

- E. If additional visits are required by the Engineer to review work not completed by this review, the Engineer shall be reimbursed directly by the Contractor by check or money order (due 10 days from date of each additional visit) at a rate of \$125.00 per hour for extra trips required to complete either of the above-ceiling or final punch lists.
- F. All panelboard fronts shall be omitted until final punch list inspection is made. Directories for each panelboard shall be completed and available for review by the Engineer at that time.

1.51 POSTED OPERATING INSTRUCTIONS

- A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:
 - 1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - 2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - 3. Safety precautions.
 - 4. The procedure in the event of equipment failure.
 - 5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.
- B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.52 TRAINING AND RELATED SUBMITTALS

- A. Upon completion of all work and all tests, Contractor shall provide classroom and in the field training for each type and/or model of equipment installed. Training shall be led by qualified factory certified technician. Contractor shall submit a request to schedule training sessions a minimum of two weeks in advance. Submission shall include qualifications of instructor as well as a syllabus that the Owner will add/deduct to as they see fit. Each individual listed as an "Attendee" on the roster submitted by the Owner shall receive a copy of the maintenance manual to review during training. All training sessions shall be recorded and a DVD with proper labels identifying the date, equipment, and project shall be delivered prior to Completion of the project. If the audio from the recording is unclear, narration shall be added. The Contractor shall certify in writing to the Engineer that such demonstrations have taken place, noting the date, time and names of the Owner's representative that were present.
- B. The training phase shall be accompanied by complete as-built documentation and the technical systems operation manual.
- C. These training sessions shall be videotaped by the Installer and copies provided to the Owner within one (1) week of training
- D. Brochures: Furnish Owner a complete set of operating instructions and diagrams.
- E. Systems/Components which require owner training. The training shall be accomplished by a factory trained representative. Include (8) hours minimum for each system described here-in. Each equipment representative shall be represented wherever their equipment is used. All training shall be videotaped by the Installer. The following systems shall include owner training at a minimum:
 - 1. Service Grounding
 - 2. Electrical Devices
 - 3. Fire Alarm Materials & Labor
- F. Instruction Program: Submit outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

- G. At completion of training, submit two complete training manual(s) for Owner's use.
 - H. Qualification Data: For facilitator, instructor and photographer.
 - I. Attendance Record: For each training module, submit list of participants and length of instruction time.
 - J. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
 - K. Demonstration and Training DVDs: Submit two copies within seven days of end of each training module.
 - L. Identification: On each copy, provide an applied label with the following information:
 - 1. Name of Project.
 - 2. Name and address of photographer.
 - 3. Name of Architect and Construction Manager.
 - 4. Name of Contractor.
 - 5. Date video was recorded.
 - 6. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - M. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy duty, 3-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video. Include name of Project and date of video on each page.
- 1.53 EQUIPMENT/SYSTEMS TESTING, VERIFICATION & START-UP
- A. The Contractor (and Sub-Contractors) shall be responsible for commissioning, starting-up, testing, checking, examining, inspecting, etc. their own systems.
 - B. The Electrical Contractor shall designate an individual under his employment to lead the start-up, testing and verification process. This person should not be the project manager or job site superintendent, but a person dedicated to making this critical task successful and completed in a timely manner.
 - C. This individual shall also be responsible for the following items:
 - 1. All identification and labeling requirements per plans and specifications.
 - 2. Submission of switchgear coordination study, fault current study, and arc flash hazard analysis.
 - D. A pre-start-up conference shall be held with the Architect, Owner, Construction Manager, Electrical Contractor, and the Manufacturers providing startup services. The purpose of this meeting will be discuss the goals, procedures, etc. for start-up.
 - E. A specific line-item shall be included on the schedule of values for testing and verification of all systems indicated in this section. This line-item value shall be approved by the Engineer. The Engineer, Owner and the Engineer's Field Inspector(s) shall closely monitor progress and quality of the testing, verification, and startup and may withhold pay requests as deemed appropriate.
 - F. The Contractor shall test all wiring and connections for continuity and grounds before equipment and fixtures are connected, and when indicated or required, demonstrate by Megger Test the insulation resistance of any circuit or group of circuits. Where such tests indicate the possibility of faulty insulation, locate the point of such fault, pull out the defective conductor, replacing same with new and demonstrate by further test the elimination of such defect.
 - G. Systems Requiring Testing & Verification:
 - 1. Fire Alarm System
 - 2. Electrical Distribution Equipment
 - 3. Lighting and Lighting Controls
 - 4. Emergency Standby Systems

5. All Low Voltage Systems
 6. Grounding Systems
 7. Wiring and Terminations
- H. The Contractor shall include in the bid to provide systems startup and verification for ALL electrical systems specified for this project. Specific startup, testing, and verification specifications are included throughout the Electrical specifications. In general, as part of the verification process, equipment suppliers shall perform start-up by their factory authorized technicians (not third party Contractors) and shall complete and submit start-up reports/checklists. Submit start-up reports to the Engineer. The Contractor shall have appropriate trades on site to correct all deficiencies noted by the factory representative. For each deficiency noted, documentation of corrective action (including date and time) shall be submitted to the Engineer and Owner. Where factory start-up is not specified for a particular piece of equipment or system, the Contractor shall be responsible to perform start-up.
- I. The Contractor shall be responsible for completion of System Verification Checklist (SVC) / Manufacturer's Checklists. Furnish to the Testing Agent and Engineer. Sample checklists shall be submitted to the Engineer, Owner, and Testing Agent for approval.
- J. The completed reports shall be organized and bound together in a tabbed binder and submitted for review and approval.
- 1.54 SPECIAL WRENCHES, TOOLS AND KEYS
- A. Each Contractor shall provide, along with the equipment provided, any special wrenches or tools necessary to dismantle or service equipment or appliances installed by him. Wrenches shall include necessary keys, handles and operators for valves, switches, breakers, etc. and keys to electrical panels, emergency generators, alarm pull boxes and panels, etc. At least two (2) of any such special wrench, keys, etc. shall be turned over to the Architect prior to completion of the project. Obtain a receipt that this has been accomplished and forward a copy to the Engineer.
- 1.55 CLOSEOUT DOCUMENTS
- A. All items listed in this section shall be provided to the engineer upon substantial completion. Provide three bound copies with complete index and tabs to locate each item.
- B. As-Built Record Drawings:
1. The Contractor shall insure that any deviations from the design are being recorded daily, as necessary, on record drawings being maintained by the Contractor. Dimensions from fixed, visible permanent lines or landmarks shown in vertical and horizontal ways shall be utilized. Compliance shall be a requirement for final payment. Pay particular attention to the location of underfloor or underground exterior in-contract or utility-owned or leased service lines, main switches and other appurtenances important to the maintenance and safety of the Electrical System. Deliver these record drawings to the Engineer as a system is completed, within ten days of the mark-up and/or while the accuracy of the mark-ups can be verified visually. Monthly payment may be withheld if the requirement is not complied with.
 2. All underground utilities/piping installed as part of this project shall be surveyed by a land surveyor licensed in the State of Indiana. This shall include underground electrical primary, communications, vaults. The survey shall include actual duct bank depths to top of conduit every 100 feet in length. The survey shall also include benchmarks dimensions relative to above grade, fixed structures. The survey shall be furnished on a compact disc in AutoCad ".dwg" format and ".pdf" format. Provide a GPS coordinate of each geothermal well and indicate on the as-built drawing. The survey information shall be included in the closeout documentation.
 3. Refer to additional record drawing requirements within the general conditions and other sections of these specifications.
- C. Start-up and System Testing Certifications and Reports:

1. Provide reports from all required testing to indicate procedures followed and complete results of all tests. Provide reports on manufacturer's standard forms for all equipment and system tests. Testing shall be per applicable NEC, NFPA, UL, NETA, and/or ANSI standards.
- D. Operation and Maintenance Manuals
1. Upon substantial completion of the project, the Contractor shall deliver to the Engineers (in addition to the required Shop Drawings) three (3) complete bound hard copies and a digital copy of operation and maintenance instructions and parts lists for all equipment provided in this contract. Formatting and content shall follow the guidelines outlined in the latest version of ASHRAE Application Handbook, Guideline 4. As a minimum, the following shall be included:
 2. All instructions shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions.
 3. Each Contractor, in the above mentioned instructions, shall include the maintenance schedule for the principal items of equipment furnished under this contract and a detailed, easy to read parts list and the name and address of the nearest source of supply.
 4. The operation and maintenance document directory should provide easy access and be well organized and clearly identified.
 5. The operation and maintenance manuals shall contain the following information:
 - a. Emergency information should be immediately available during emergencies and should include emergency and staff and/or agency notification procedures.
 - b. Provide contacts (company name, address, phone number, email) where parts may be purchased for all equipment.
 - c. Provide detailed maintenance instructions, including recommended preventative maintenance schedules for all equipment requiring maintenance. For lighting and lighting controls, provide recommended re-lamping program, provide a schedule for inspecting and recalibrating lighting controls, and provide a recommended settings list for all components with adjustable settings.
 - d. General Information. Provide the following:
 - 1) Building function
 - 2) Building description
 - 3) Operating standards and logs
 - e. Technical Information. Provide the following:
 - 1) System description
 - 2) Operating routines and procedures
 - 3) Seasonal start-up and shutdown
 - 4) Special procedures
 - 5) Basic troubleshooting
 - f. The maintenance manual should contain the following information:
 - 1) Equipment data sheets. Provide the following:
 - a) Vendor and local representative's contact information
 - b) Operating and nameplate data
 - c) Warranty
 - d) Detailed operating instructions.
 - e) Tools required
 - f) Types of cleaners to use
 - 2) Maintenance program information. Provide the following:
 - a) Manufacturer's installation, operation, and maintenance instructions
 - b) Spare parts information
 - c) Preventive maintenance actions

- d) Schedule of actions
 - e) Action description
 - f) History
 - g. Test reports document observed performance during start-up and commissioning.
 - h. Reference Division 1 specifications for additional requirements.
- E. Shop drawings will not be accepted as satisfying the requirement for Operation and Maintenance Manuals.
 - F. Shop Drawings: Provide complete copies of all approved shop drawings. Where shop drawings were returned "Furnish as Corrected", the contractor shall make the corrections noted by the engineer and submit final corrected shop drawings with close-out documentation.
 - G. Parts Lists: Provide an inventory of all spare parts, special tools, attic stock, etc. that have been provided to the owner.
 - H. Warranties: Contractor's one-year warranty and all other specific warranties indicated in the construction documents.
 - I. Training Verification: Provide certification that all specified training has been completed. List training session dates, times, and types.
 - J. Inspection Certificates: Provide certificates of inspection from electrical inspector, fire marshal, and any other required special inspections.
 - K. Panel Schedules: Provide hard copies and digital copies of Excel files for all panel-board schedules.
 - L. Final Power System Study Reports.
 - M. Fire Alarm System Certification.
 - N. Power Riser Diagram: Provide a framed full-size copy of the overall power riser diagram (under glass) to the Owner. Also, provide three (3) vinyl-coated copies of same. Where an existing power riser diagram is present, the Contractor shall obtain the document from the Owner, and update in digital format with the scope of this project. Edits shall be in digital format and this work shall be closely coordinated with the Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION (260501)

DIVISION 26 - ELECTRICALSECTION 260502 - SCOPE OF THE ELECTRICAL WORKPART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.

Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SCOPE OF THE ELECTRICAL WORK

The Electrical work for this project includes all labor, materials, equipment, fixtures, excavation, backfill and related items required to completely install, test, verify place in service and deliver to the Owner complete electrical systems in accordance with the accompanying plans and all provisions of these specifications. This work shall primarily include, but is not limited to the following:

1. All raceways, conduits, cable management systems, cable trays, J-hooks, conductors, outlet boxes, fittings, pull boxes, manholes, etc.
2. All low-voltage distribution equipment, switchboards, panelboards, disconnect switches, fuses, transformers, contactors, starters, etc.
3. Electrical Studies including Fault Current, Arc Flash, and Coordination Studies. All studies to be performed by manufacturer of electrical distribution equipment.
4. Electrical Contractor shall install, mount and wire VFD's which shall be furnished by the Mechanical Contractor, unless otherwise noted.
5. All wiring devices and device plates.
6. Cable splicing, terminations, supports, etc.
7. Electrical connection to all electrically operated equipment furnished and/or installed by others, including powered casework, mechanical equipment, etc.
8. Grounding, per NEC and specified requirements.
9. Identification of electrical systems and equipment labeling.
10. All low-voltage systems as listed in System Responsibilities Matrix on Electrical Legend.
11. Pathways and raceways for Voice/Data system shall be provided by Division 26 Contractor in accordance with Division 26 and 27 Specifications. All other Division 27 infrastructure shall be provided by the Division 27 Contractor.
12. Fire alarm system in accordance with Division 28 Specifications.
13. All necessary coordination with the Owner, electric utility company, telephone company, cable television company, etc. to ensure that work, connections, etc., that they are to provide is accomplished and that service to this facility is delivered complete prior to occupancy.
14. Paying all necessary fees and costs for inspections of all Division 26, 27 and 28 systems by a Licensed Electrical Inspector.
15. Paying all necessary fees and cost for permits, electrical inspections, work by utility companies (power, telephone, cable television company, etc.). The Contractor shall contact the utility companies prior to submitting a bid to determine exactly these charges will be.
16. Prior to submitting a bid, the Contractor shall contact all serving utility companies and municipal services to determine exactly what each utility company will provide and exactly what is required

of the Contractor and the Contractor shall include all such requirements in his base bid. This shall include relocation fees and construction cost recovery due to Power Utility Company and Cable Company or their successors.

17. All general and special conditions required to accomplish the work.
18. Special Note: A specialty sub-contractor (Electronic Systems Contractor) shall be utilized for all video, paging-intercom system, data/voice network, fire alarm work, sound systems and for the security system installation. The sub-contractor shall be especially skilled in such work and shall be able to demonstrate that their regular business involves such installations. The specialty sub-contractor(s) shall be acceptable to and approved by the Owner. The names of each such sub-contractor shall be listed on the form of proposal at the time of opening bids. Provisions for branch circuits, pulling of cabling, and installation of raceways for specialty systems may be regular sub-contractor if approved by specialty contractor. All terminations, connections, check-out and testing shall be by specialty contractor.
19. Prior to commencing any work, contractor shall provide this Engineer and the Owner with a pre-certification of the entire fire alarm, security, video surveillance, AI-phone, video, sound, and intercom systems. This test shall be in writing and shall be performed immediately after receipt of notice to proceed. No work is to commence until owner is in possession of certification. The Owner will then instruct on how to proceed with connections of any found problems. Failure of the contractor to perform this work in a timely fashion will not result in a change or time extension to the project. The data/voice system will be assumed without problems and the contractor shall be responsible for any problems found during or after construction.

END OF SECTION

DIVISION 26 - ELECTRICALSECTION 260503 - SHOP DRAWINGS, SUBMITTALS, LITERATURE, MANUALS, PARTS LISTS, AND SPECIAL TOOLSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Each Contractor shall submit to the Architect and/or Engineer, within thirty days after the date of the Contract, one (1) set of shop drawings and/or manufacturer's descriptive literature on all equipment required for the fulfillment of his contract. Each shop drawing and/or manufacturer's descriptive literature shall have proper notation indicated on it and shall be clearly referenced so the specifications, schedules, light fixture numbers, panel names and numbers, etc., so that the Architect and/or Engineer may readily determine the particular item the Contractor proposes to furnish. All data and information scheduled, noted or specified by hand shall be noted in color red on the submittals. The Contractor shall make any corrections or changes required and shall resubmit for final review as requested. Review of such drawings, descriptive literature and/or schedules shall not relieve the Contractor from responsibility for deviation from drawings or specifications unless they have, in writing, directed the reviewer's attention to such deviations at the time of submission of drawings, literature and manuals; nor shall it relieve them from responsibility for errors or omissions of any nature in shop drawings, literature and manuals. The term "as specified" will not be accepted.
- B. If the Contractor fails to comply with the requirements set forth above, the Architect and/or Engineer shall have the option of selecting any or all items listed in the specifications or on the drawings, and the Contractor will be required to provide all materials in accordance with this list.
- C. Review of shop drawings by the Engineer applies only to conformance with the design concept of the project and general compliance with the information given in the contract documents. In all cases, the installing Contractor alone shall be responsible for furnishing the proper quantity of equipment and/or materials required, for seeing that all equipment fits the available space in a satisfactory manner and that piping, electrical and all other connections are suitably located.
- D. The Engineer's review of shop drawings, schedules or other required submittal data shall not relieve the Contractor from responsibility for the adaptability of the equipment or materials to the project, compliance with applicable codes, rules, regulations, information that pertains to fabrication and installation, dimensions and quantities, electrical characteristics, and coordination of the work with all other trades involved in this project.
- E. No cutting, fitting, rough-in, connections, etc., shall be accomplished until reviewed equipment shop drawings are in the hands of the Contractors concerned. It shall be each Contractor's responsibility to obtain reviewed shop drawings and to make all connections, etc. in the neatest and most workmanlike manner possible. Each Contractor shall coordinate with all the other Contractors having any connections,

roughing-in, etc., to the equipment, to make certain proper fit, space coordination, voltage and phase relationships are accomplished.

- F. Shop Drawings: Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
- G. Product Data: Submittal shall include performance and characteristic curves.

1.3 SUBMITTALS AND SHOP DRAWING

- A. In accord with the provisions specified hereinbefore, shop drawings, descriptive literature and schedules shall be submitted on each of the following indicated items as well as any equipment or systems deemed necessary by the Engineer:
 - 1. Power Equipment
 - a. Fault Current, Arc Flash and Coordination studies (submit along with switchgear & panelboards).
 - b. Switchgear, switchboards, distribution panelboards and panelboards.
 - c. Circuit breakers and fusible switches, per each type.
 - d. Power and lighting contactors.
 - e. Disconnect switches.
 - f. Fuses, per each type required.
 - g. Magnetic starters, if not submitted with unit equipment by supplier.
 - h. Control components (relays, timers, selector switches, pilots, etc.)
 - i. Motor starters, if not submitted with unit equipment by supplier.
 - j. Building service grounding electrode components.
 - k. Metering devices.
 - l. Complete grounding system.
 - 2. Raceways
 - a. Conduits and each type of conduit fittings.
 - b. Surface-mounted metal or plastic raceways, with each type of fitting.
 - c. Wireways and each type of wireway fitting.
 - d. J-hook assembly.
 - e. Floor trough and each type of floor trough fitting.
 - f. Composite pullboxes.
 - 3. Conductors
 - a. Conductors, splicing devices, and connectors, each by type.
 - b. Splice or tap blocks.
 - 4. Devices
 - a. Each type of wiring device and their coverplates.
 - b. Floor boxes and poke-thrus, each by type, with required accessories.
 - c. Any special items not listed above.
 - 5. Fire alarm system.
 - a. Note: Each system submittal is to be complete with legible cutsheets for all devices, equipment, special wiring, etc. Include system specific wiring schematics showing each device and its specific interconnect/wiring requirements. For rack mounted equipment,

provide a scalable elevation drawing with proposed component locations & specific interconnect wiring requirements for each component/panel. Also provide scale building specific layout drawings that indicate device placement, wiring, etc. Refer to the specific system's specification for additional submittal requirements where required.

6. Grounding
 - a. Electrodes, bonding devices, terminals, etc.
 - b. Building service grounding electrode components.
7. Electronic 3D Coordination Drawings per Electrical General Provisions
8. Dimensioned electrical room plans/equipment layouts
9. Fire-stopping materials including wrap, caulk, putty, sleeves, etc.
10. Miscellaneous
 - a. Control panel assemblies.
 - b. Non-standard junction/pullboxes.
 - c. Manholes, hand holes, and all outdoor electrical equipment and fittings.
 - d. Floor plan and riser drawings that show the location of all fire alarm devices.
 - e. Floor plan and riser drawings that show the location of all low-voltage systems.
11. Systems
 - a. Note: Each system submittal is to be complete with legible cutsheets for all devices, equipment, special wiring, etc. Also, provide scale building layout drawings that indicate device placement, wiring, etc. Drawings shall be in digital format and shall include complete (not typical) riser diagrams of all systems. Refer to specific system's specification for additional submittal requirements where required.
 - b. Fire alarm system
 - c. All other systems as listed on Systems Responsibility Matrix - See Electrical Legend.
12. Special wrenches, tools and keys

1.4 FIRE ALARM SHOP DRAWINGS

- A. The Contractor and equipment supplier shall submit to the Architect and/or Engineer, fire alarm system shop drawings complete with catalog cuts, descriptive literature and complete system wiring diagrams for their review prior to the Contractor's submittal to the Indiana Building Plan Review, Buildings and Construction or other governing authority for their review. No work shall be done until drawings are approved by the Indiana Building Plan Review, Buildings and Construction.
- B. Fire alarm drawings shall be created in digital format (CAD or equivalent). Drawings shall include all power supply, battery, and circuit load and voltage drop calculations as required by NFPA. Complete wiring diagrams and proposed device addresses shall be provided.
- C. Shop drawings shall indicate all devices as required to satisfy all local and state mandates, whether indicated on construction drawings or not. Include all components as required for a complete and operational system.
- D. Provide battery back-up calculations indicating batteries have capacity to provide emergency power to the system in compliance with NFPA.
- E. Provide name, location and UL number of UL listed Central Station Monitoring System.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260504 - SLEEVING, CUTTING, PATCHING AND REPAIRING FOR ELECTRICAL SYSTEMSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 SUMMARY

- A. The Contractor shall be responsible for all openings, sleeves, trenches, etc. that he may require in floors, roofs, ceilings, walls, etc. and shall coordinate all such work with the Construction Manager, General Contractor and all other trades. He shall determine and coordinate any openings which he is to provide before submitting a bid proposal in order to avoid conflict and disagreement during construction. Improperly located openings shall be reworked at the expense of the responsible Contractor.
- B. The Contractor shall plan his work ahead and shall place sleeves, frames or forms through all walls, floors and ceilings during the initial construction, where it is necessary for conduit, conductors, wireways, etc. to go through; however, when this is not done, this Contractor shall do all cutting and patching required for the installation of his work, or he shall pay other trades for doing this work when so directed by the Architect. Any damage caused to the buildings by the workmen of the responsible Contractor must be corrected or rectified by him at his own expense.
- C. The Contractor shall cut holes in casework, equipment panels, etc. (if any), as required to pass pipes in and out.
- D. The Contractor shall notify other trades in due time where he will require openings of chases in new concrete or masonry. He shall set all concrete inserts and sleeves for his work. Failing to do this, he shall cut openings for his work and patch same as required at his own expense.
- E. Openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.
- F. Where any cutting, coring, etc. of reinforced concrete is required, such structures shall be x-rayed to avoid damaging existing reinforcing steel.
- G. Where sleeves are placed in exterior walls below grade, the space between the pipe or conduit and the sleeves shall be made completely water tight. Provide Crouse-Hinds Link-Seal Environmental Conduit Seal with stainless steel hardware. Alternative methods shall be approved by the Engineer and/or Architect during shop drawing review.
- H. In all cases, sleeves shall be at least two pipe sizes larger than nominal pipe diameter.
- I. All roof penetrations shall be made inside mechanical equipment curbs, UON.

- J. Sleeves passing through roof or exterior wall or where there is a possibility of water leakage and damage shall be caulked water tight for horizontal sleeves and flashed and counter-flashed with lead (4 lb.) or copper and soldered to the piping, lapped over sleeve and properly weather sealed.
- K. All rectangular or special shaped openings in plaster, stucco or similar materials including gypsum board shall be framed by means of plaster frames, casing beads, wood or metal angle members as required. The intent of this requirements is to provide smooth even termination of wall, floor and ceiling finishes as well as to provide a fastening means for lighting fixtures, panels, etc. Lintels shall be provided where indicated over all openings in bearing walls, etc.
- L. No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Architect and Structural Engineer.
- M. The Contractor shall be responsible for properly shoring, bracing, supporting, etc. any existing and/or new construction to guard against cracking, settling, collapsing, displacing or weakening while openings are being made. Any damage occurring to the existing and/or new structures, due to failure to exercise proper precautions or due to action of the elements, shall be promptly and properly made good to the satisfaction of the Architect.
- N. All work improperly done or not done at all as required by the Electrical trades in this section will be performed by the Contractor at the direction of the trade whose work is affected. The cost of this work shall be paid for by the Contractor who is in non-compliance with the Contract.
- O. All penetrations shall be patched with materials matching that which has been disturbed.

PART 2 - PRODUCTS

2.1 SLEEVES

2.2 SLEEVES

- A. Sleeves for Raceways:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, hot-dipped galvanized, plain ends.
 - a. Sleeves for exterior walls: Anchor flange welded to perimeter.
- B. Sleeves for Raceways Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel of length to suit application.
 - 2. Minimum Metal Thickness: Shall be 0.138 inch (10 gauge).
- D. Coordinate sleeve selection and application with selection and application of firestopping.

2.3 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and conduit.
 - 1. Sealing elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting bolts and nuts: Stainless-steel of length required to secure plates to sealing elements. Include one for each sealing element.

2.4 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. The Contractor shall provide and locate all sleeves and inserts required for his work before the floors and surface being penetrated are built, otherwise the Contractor shall core drill for conduits where sleeves and inserts were not installed, or where incorrectly located. Core drilling is the only acceptable alternative to sleeves. Do not chisel openings. Where sleeves are placed in exterior walls or in slabs on grade, the space between the conduit and the sleeves shall be made completely and permanently water tight.
- D. Conduits that penetrate fire and/or smoke rated assemblies shall have sleeves installed as required by the manufacturer of the rating seal used.
- E. Fasten sleeves securely in floors, walls, so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster or other materials being forced into the space between pipe and sleeve during construction.
- F. Sleeves in floors shall extend 4" above finished floor level.
- G. Escutcheon plates shall be provided for all conduits passing thru walls, floors and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the conduit. Where plates are provided for conduits passing thru sleeves which extend above the floor surface, provide deep recessed plates to conceal the conduit sleeves.
- H. In all areas where busducts are exposed and pass thru floors, the opening shall be surrounded by a 4-inch-high by 3-inch-wide concrete curb.
- I. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

3.2 CUTTING

- A. No cutting is to be done at points or in a manner that will weaken the structure and unnecessary cutting must be avoided. If in doubt, contact the Engineer.
- B. Conduit openings in slabs and walls shall be cut with core drill. Hammer devices will not be permitted. Edges of trenches and large openings shall be scribe cut with a masonry saw.
- C. X-ray concrete slabs and walls prior to core drilling. Do not core drill through rebar, steel or reinforcing material without written permission from the Structural Engineer and Architect.
- D. Openings in metal building walls shall be made in strict accord with building suppliers recommendations.

3.3 PATCHING AND REPAIRING

- A. Patching and repairing made necessary by work performed under this division shall be included as a part of the work and shall be done by skilled mechanics of the trade or trades for work cut or damaged, in

strict accordance with the provisions herein before specified for work of like type to match adjacent surfaces and in a manner acceptable to the Engineer.

- B. Where portions of existing lawns, shrubs, paving, etc. are disturbed for installation of work of this Division, such items shall be repaired and/or replaced to the satisfaction of the Engineer.
- C. Where the installation of conduit, raceways, etc. requires the penetration of fire or smoke rated walls, ceilings or floors, the space around such conduit, raceways, etc., shall be tightly filled with an approved non-combustible fire insulating material satisfactory to maintain the rating integrity of the wall, floor or ceilings affected.
- D. Conduits passing through floors, ceilings and walls in finished areas, unless otherwise specified, shall be fitted with chrome plated brass escutcheons of sufficient outside diameter to amply cover the sleeved openings and an inside diameter to closely fit the conduit around which it is installed.
- E. Stainless steel collars shall be provided around all conduits, raceways, etc., at all wall penetrations; both sides where exposed.
- F. Where conduits pass through interior or exterior walls, the wall openings shall be sealed air tight. This shall include sealing on both sides of the wall to insure air does not enter or exit the wall cavity. This is especially critical on exterior walls where the wall cavity may be vented to the exterior.

END OF SECTION

DIVISION 26 – ELECTRICAL

SECTION 260505 – EXCAVATION, TRENCHING, BACKFILLING AND GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Each Contractor shall include all excavating, filling, grading and related items required to complete his work as shown on the drawings and specified herein.
- B. Electrical distribution lines and underground telephone or TV cables shall, in no case, be placed in the same trench with sanitary, storm, domestic or fire protection water lines. Telephone or cable TV services shall, in all cases, be placed in a separate trench with minimum two feet separation from electrical power lines.
- C. Depths of bury shall be:
 - 1. 48" minimum to top of primary ducts, unless otherwise noted.
 - 2. 42" minimum to top of secondary ducts, unless otherwise noted.
 - 3. 36" minimum to top of branch exterior circuits, unless otherwise noted.
 - 4. 36" minimum to top of fiber/telephone/communication/misc. ducts, unless otherwise noted.

1.3 SUBSURFACE DATA

- A. Subsurface investigations have been made and the results shown on the drawings. The information was obtained primarily for use in preparing foundation design. Each Contractor may draw his own conclusions therefrom. No responsibility is assumed by the Owner for subsoil quality or conditions other than at the locations and at the time investigations were made.
- B. Materials to be excavated shall be unclassified, and shall include earth, rock, or any other material encountered in the excavation to the depth and extent indicated on the drawings and specified herein. No adjustment in the Contract sum will be made on account of the presence or absence of rock, shale, or other materials encountered in the excavating.

1.4 BENCH MARKS AND MONUMENTS

- A. Maintain carefully all bench marks, monuments and other referenced points. If disturbed or destroyed, replace as directed.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Each Contractor shall accept the site as he finds it and remove all trash, rubbish and material from the site prior to starting excavation for his work.
- B. Excavate trenches to sufficient width and depth for proper installation of the work and where required, smooth the bottom on the trench with hand tools in strict accordance with OSHA Guidelines.
- C. The removal of rock shall be accomplished by use of hand or power tools only. Blasting shall not be permitted unless authorized in writing by the Architect. Any damage to existing structures, exterior services or rock intended for bearing, shall be corrected at the responsible Contractor's expense.
- D. Keep trenches free from water while construction therein is in progress. Under no circumstances lay conduit or cable in water. Pumping or bailing water from this Contractor's trenches, which is required during construction shall be accomplished at his expense.
- E. In no case shall excavation work be accomplished that will damage in any way the new structure, existing structures, equipment, etc. Each Contractor shall take the necessary steps to prevent flow of eroded earth by water or landslide onto the property of others, or against the structures. The repair of all such damage, or any other damage incurred in the course of excavation, shall be borne by the responsible Contractor. Restore all disturbed areas to original condition.

3.2 BACKFILL

- A. Concrete for concrete encasement shall cure a minimum of 3 days prior to backfill.
- B. Backfill shall be accomplished with clean debris free earth and the backfill compacted to 95% standard Proctor in 6" lifts so as to avoid earth sinks along the trench. The responsible Contractor will be required to return to the project and fill any sunken areas along the route of his work.
- C. Backfill trenches only after conduit and cable have been inspected by Agencies, Engineer and Owner, tested, and locations of pipe lines have been recorded on record drawings. Provide at least one week's written or fax notification to all parties of impending work that needs to be reviewed.
- D. The backfill below paved areas shall be sand and brought to proper grade in 6" lifts compacted to 98% standard Proctor to receive the sub-base and paving. No paving shall be placed on uncompacted fill.
- E. The backfill below sodded or seeded areas shall be brought to within six inches of finished grade. The remaining six inches shall be backfilled with clean soil.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260506 – DEMOLITION, RESTORATION AND SALVAGEPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. This section includes electrical demolition, patching, disposal and salvaging requirements.
- B. This Section includes all labor, material, equipment and services necessary and incidental to complete all the demolition and removal of electrical work as shown on the Drawings or as required.
- C. The demolition drawings do not necessarily indicate all the conditions, details, or work required. The Contractor shall examine the building to determine the actual conditions and extent of the work. Any details not clear to this Contractor shall be referred to the Architect/Engineer for clarification prior to bidding.
- D. The Contractor shall be responsible for demolition and removal of all existing electrical systems where shown for demolition. No portion of electrical systems shown for demolition may be abandoned in place.

1.3 DESCRIPTION OF WORK

- A. This section covers all demolition, restoration and salvage required to perform the electrical work indicated on the drawings, specified and/or as required to complete the project. It is the intent of this section of work to remove all existing electrical equipment, materials, etc. which are not required for the completed building and to restore any and all finished surfaces to their original type and conditions. To accomplish these requirements, the Contractor(s) shall, at his own expense, engage the services of others already performing finish work on this project. All work shall be completed to the satisfaction of the Architect/Engineers whose decisions shall be final. This requirement shall apply to all restoration work whether indicated or specified.
- B. Electrical Contractor shall re-pull new wire/cable to all devices and equipment that have been cut-off from a panelboard or electronics due to demolition work. Contractor shall check/test all devices and verify they are functional.
- C. All adjacent areas need to remain in operation and services to other areas need to be maintained during demolition.
- D. Schedule all demolition and any outages affecting other areas with owner.
- E. Provide and maintain temporary partitions and/or dust barrier per Owner's dust control plan.

1.4 SCHEDULING

- A. Schedule work to coincide with new construction.

- B. Cease operations immediately when structure appears to be in danger and notify Architect. Do not resume operations until directed.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA, NEC and OSHA requirements.
- B. Contractor shall verify the extent of the demolition work. Any questions as to which systems are to be removed versus which systems are to remain shall be referred to the Architect/Engineer for clarification prior to commencing demolition work.
- C. The demolition work shall be a phased operation and shall comply with the construction sequence schedule. The Contractor shall submit a schedule of demolition work 14 days prior to the start of work. The Contractor shall not proceed with the work until receiving written approval.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate electrical system demolition with other systems being demolished.

1.7 SITE SURVEY

- A. Before submitting bid, bidder shall carefully examine existing field conditions, including the main power and power distribution system. Claims for extra labor, equipment and materials required due to existing conditions, which could have been foreseen, will not be recognized.

1.8 ELECTRICAL

- A. Where electrical fixtures, equipment or other materials are removed and/or relocated, all abandoned conduit and conductors shall be removed in exposed areas. In concealed areas, materials shall be abandoned in place or removed as indicated and patch all openings. Contractor shall remove all conduit, wire, connections, etc. for electrical items being demolished. Contractor shall maintain continuity of existing circuits where removed items do not represent the complete circuit and devices. Field verify exact requirements.
- B. The Contractor shall be responsible for the removal and/or relocation of any electrical equipment, fixtures, devices, appurtenances, etc. which may, in the course of construction, interfere with the installation of any new and/or relocated Architectural, Mechanical, Electrical, Structural or Fire Protection Systems whether indicated or not.
- C. Relocate junction boxes and provide low-voltage raceways and supports for existing cabling in areas above new inaccessible ceilings.
- D. Where components of any system in this Contractor's scope of work are to be reused, the contractor shall test those components prior to removal and record the state of functionality and condition of the components as tested. These records shall be provided to the owner or engineer upon request. In the absence of these records, all components removed shall be assumed functional at the time of removal. Any device subsequently found to be non-functioning or in unsuitable condition for reuse shall be replaced at the expense of the contractor.

1.9 REPAIR

- A. Unless otherwise indicated, the Contractor shall be responsible for the patching and repairing of all holes, etc. in the ceiling, wall and floors where electrical equipment is removed. Patching shall be accomplished with similar materials to the existing ceilings, walls and floors and shall match adjacent surfaces.

1.10 COORDINATION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Coordinating and sequence demolition so as not to cause shutdown of operation of surrounding areas.

- C. Coordinate demolition of all affected electrical systems to prevent disruption to the Owner and minimize downtime.
- D. Coordinate demolition by other Divisions of the Specifications to prevent disruption to the Owner and minimize the downtime.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- B. Verify termination points for demolished services.
- C. Verify field measurements and circuiting arrangements are as shown on Drawings.
- D. Verify that abandoned wiring and equipment serve only abandoned facilities.
- E. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- F. Beginning of demolition means installer accepts existing conditions.

3.2 DOCUMENTATION

- A. Contractor is responsible for submitting photos and documenting existing conditions to Owner prior to commencing demolition. Systems and equipment found to be defective after demolition has commenced shall be repaired or replaced by Contractor at no additional cost to Owner.

3.3 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- B. All existing computer equipment racks and open or closed raceways must be covered before start of Work.
- C. Use temporary egress signage and emergency lighting as needed.
- D. Thoroughly examine, review and document all existing infrastructure conditions to determine use. Submit plan to Owner detailing all planned modifications to existing conditions and new work. Owner shall provide written approval to Contractor before proceeding with work.
- E. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- F. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.4 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

- B. Remove demolished material from Project site, except as indicated on drawings.
- C. Remove all existing concrete pads supporting electrical equipment complete. Existing concrete pads shall not be re-used.
- D. Remove abandoned wiring to source of supply.
- E. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- G. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- H. Remove abandoned conduit, wire, boxes, and fastening devices including abandoned conduit, wire, boxes, and fastening devices above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- I. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- J. Reconnect equipment being disturbed by renovation work and required for continued Service.
- K. Disconnect or shut-off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring that are not part of final project.
- L. Install temporary wiring and connections to maintain existing systems in service during construction.
- M. Perform work on energized equipment or circuits with experienced and trained personnel.
- N. Remove, relocate, and extend existing installations to accommodate new construction.
- O. Repair adjacent construction and finishes damaged during demolition and extension work.
- P. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes and below raised floor areas. Cut embedded support elements flush with walls and floors.
- Q. Clean and repair existing equipment to remain or to be reinstalled.
- R. Protect and retain power to existing active equipment remaining.
- S. Cap abandoned empty conduit at both ends.
- T. Repair adjacent construction and finishes damaged during demolition and extension work. T-bar ceiling tiles damaged under normal construction conditions or having voids where junction boxes were removed shall be replaced by the Contractor.
- U. Maintain access to existing electrical installations which remain active.
- V. Where materials or equipment are to be turned over to Owner or reused and installed by the Contractor, it shall be the Contractor's responsibility to maintain condition of materials and equipment equal to the existing condition of the equipment before the work began. Repair or replace damaged materials or equipment at no additional cost to the Owner.

3.5 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Disconnect and tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.

- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories where circuits have been modified or rewired.

3.6 LAMP DISPOSAL

- A. Contractor shall be responsible for the careful removal of all lamps and fluorescent tubes without breakage from existing lighting fixtures.
- B. Lamps removed from fluorescent, metal halide, mercury vapor, and sodium fixtures shall be placed by the Contractor in cardboard boxes. The Contractor shall label each box with type and quantity of lamps in each box and seal the box. Boxes shall be properly disposed of by the Contractor.
- C. Broken, fluorescent, metal halide, mercury vapor, and sodium lamps without green end caps shall be immediately and carefully cleaned up by the Contractor and placed in a 55 gallon steel drum. 55 gallon steel drums shall properly dispose of by the Contractor.
- D. All incandescent lamps shall be disposed of by the Contractor in his dumpster.

3.7 MASONRY UNIT REMOVAL AND REPLACEMENT

- A. Carefully demolish or remove entire concrete masonry unit (CMU) block face from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with new full-size CMU block face.
- B. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.
- C. Clean CMU surrounding removal areas by removing mortar, duct, and loose particles in preparation for replacement.
- D. Install replacement CMU into bonding and coursing pattern of existing units. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
- E. Lay replacement units with completely filed bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding masonry that has ASTM C67 initial rates of absorption of more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid. Maintain joint width for replacement units to match existing joints.
- F. Tool exposed mortar joints in repaired areas to match joints of surrounding existing masonry.
- G. Rake out mortar used for laying masonry before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at the same time as repointing of surrounding area.
- H. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or fiber brushes, and clean water, spray applied at low pressure. Do not use metal scrapers or brushes. Do not use acidic or alkaline cleaners.
- I. Wash adjacent non-masonry surfaces. Use detergent and soft brushes or cloths suitable for surface material being cleaned.
- J. Sweep and rake adjacent pavement, concrete and ground to remove masonry debris. Where necessary, pressure wash surfaces to remove mortar, dust, dirt and stains.

3.8 SALVAGE

- A. It is the intent of this section to deliver to the Owner all components of any electrical system (including fire alarm systems) which they may want to salvage. The Contractor shall make every effort to remove reusable components without damage. Coordinate removal with the owner and deliver to maintenance all

items the owner requests from demolition. These items typically include switchgear, fire alarm system, public address system, etc.

- B. All salvaged equipment shall be delivered to Owner at **Insert Location**.

3.9 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures that are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- C. Relocate existing lighting fixtures as needed. Test fixture to see if it is in good working condition before installation at new location. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring that are not part of final project.

3.10 CLEANING AND REPAIR

- A. Remove demolished materials as work progresses. Legally recycle or dispose.
- B. Keep workplace neat on a daily basis.
- C. Clean and repair existing materials and equipment which remain or are to be reused.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260508 - COORDINATION AMONG TRADES, SYSTEMS INTERFACING AND CONNECTION OF EQUIPMENT FURNISHED BY OTHERSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 COORDINATION

- A. The Contractor is expressly directed to read the General Conditions and all sections of these specifications for all other trades and to study all drawings applicable to his work, including Architectural, Plumbing Fire Protection, Mechanical and Structural drawings, to the end that complete coordination between trades will be affected. Each Contractor shall make known to all other Contractors the intended positioning of materials, raceways, supports, equipment and the intended order of his work. Coordinate all work with other trades and proceed with the installation in a manner that will not create delays for other trades or affect the Owner's operations.
- B. Special attention to coordination shall be given to points where raceways, fixtures, etc., must cross other ducts or conduit, where lighting fixtures must be recessed in ceilings, and where fixtures, conduit and devices must recess into walls, soffits, columns, etc. It shall be the responsibility of each Contractor to leave the necessary room for other trades. No extra compensation or time will be allowed to cover the cost of removing fixtures, devices, conduit, ducts, etc. or equipment found encroaching on space required by others.
- C. The Contractor shall be responsible for coordination with all trades to ensure that they have made provision for connections, operational switches, disconnect switches, fused disconnects, etc., for electrically operated equipment provided under this or any other division of the specifications, or as called for on the drawings. Any connection, circuiting, disconnects, fuses, etc. that are required for equipment operation shall be provided as a part of this contract.
- D. Review and coordinate connections to electrically operated equipment furnished by other trades with project contract documents, shop drawings, submittals, and installation instructions. Notify architect in writing of discrepancies prior to proceeding with work. No extra payment will be allowed for relocation of fixtures, devices, conduit, and equipment not installed or connected in accordance with the above instructions.
- E. If any discrepancies occur between accompanying drawings and these specifications and drawings and specifications covering other trade's work, each trade shall report such discrepancies to the Architect far enough in advance so that a workable solution can be presented. No extra payment will be allowed for relocation of fixtures, devices, conduit, and equipment not installed or connected in accordance with the above instructions.
- F. In all areas where air diffusers, devices, lighting fixtures and other ceiling-mounted devices are to be installed, the Mechanical Trade(s), the Electrical Trade and the General Trades shall coordinate their respective construction and installations so as to provide a combined symmetrical arrangement that is

acceptable to the Architect and Engineer. Where applicable, refer to reflected ceiling plans. Request layouts from the Architect or Engineer where in doubt about the potential acceptability of an installation.

- G. Refer to equipment schedules and details on all contract documents for additional information for mechanical and plumbing connections. Provide labor and materials for a complete and operable system.
- H. Provide equipment overcurrent protection and feeder sizes for equipment furnished by this or other trades or by Owner per actual equipment nameplates and installation instructions.
- I. Provide weather-proof/weather-resistant maintenance receptacles within 25 feet of all mechanical and plumbing units/equipment. Coordinate installation locations with final equipment layout provided by Mechanical Contractor. Provide GFI branch circuit for each maintenance receptacle to nearest panelboard unless circuit is otherwise noted on drawings.
- J. Verify exact mounting locations and connection requirements of all mechanical equipment with the Mechanical Contractor prior to rough-in.
- K. Verify exact mounting locations and connection requirements of all plumbing equipment with the Plumbing Contractor prior to rough-in.

1.3 INTERFACING

- A. Each Electrical Trade, Specialty Controls Trade, Mechanical Trade, Plumbing Trade, Fire Protection Trade and the General Trades, etc., shall insure that coordination is affected relative to interfacing of all systems. Some typical interface points are (but not necessarily all):
 - 1. Connection of all controls to equipment.
 - 2. Electrical power connections to electrically operated (or controlled) equipment.
 - 3. Electrical provisions for all equipment provided by other trades or suppliers within this contract.
 - 4. Contractor is to provide conduit whips and back boxes, as needed, to power systems furniture.
 - 5. Coordination of connection of Telecommunications (voice, data, video) lines to Owner's existing or new service.
 - 6. Connection of utility electrical service to Owner's existing or new services.

1.4 CONNECTION OF EQUIPMENT FURNISHED BY OTHERS

- A. Each Contractor shall make all connections to equipment furnished by others, whenever such equipment is shown on any part of the drawings or mentioned in any part of the Specifications, unless otherwise specifically specified hereinafter.
- B. All drawings are complementary, one trade of the other. It is the Contractor's responsibility to examine all drawings and specifications to determine the full scope of his work. The project Engineers have arranged the specifications and drawings in their given order solely as a convenience in organizing the project, and in no way shall they imply the assignment of work to specific trades, contractors, subcontractors or suppliers.
- C. Supervision to assure proper installation, functioning and operation shall be provided by the Contractor furnishing the equipment or apparatus to be connected.
- D. Items indicated on the drawings as rough-in only (RIO) will be connected by the equipment supplier or Owner, as indicated. The Contractor shall be responsible for rough-in provisions only as indicated. These rough-ins shall be in accord with the manufacturer's or supplier's requirements.
- E. For items furnished by others, relocated, or RIO, the Contractor shall obtain from the supplier or shall field determine as appropriate, the exact rough-in locations and connection sizes for the referenced equipment.
- F. The Contractor shall be responsible for coordinating with the General and all other trades, as necessary, to determine any and all final connections that he is to make to equipment furnished by others.

- G. Sides of cable, basket and ladder trays shall not be obstructed with special attention to pipes, ductwork, raceways, equipment, cables, etc.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide power wiring from the motor starters to each motor and its manual controlling device.
 - 1. Make flexible or liquid tight connections as specified in Section 260533, Raceways
- B. Except where provided with equipment, furnish and install manual pushbutton stations and pilot lights, with wiring. Where stations and pilot lights are grouped at central locations, mount them under a common faceplate.
- C. Certain equipment, as indicated, will be furnished with control panels and auxiliary control components. Mount the panels, furnish and install source wiring and disconnects, and completely connect controls and motors.
- D. Where a specification sections require installation of equipment under supervision of equipment manufacturer's representative, coordinate electrical installation to cooperate with representative's requirements.
- E. Provide power sources for Owner-furnished equipment.
- F. Provide power and control wiring for emergency generator, controllers, and remote-control panels.

END OF SECTION 260508

DIVISION 26 – ELECTRICALSECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER, CONDUCTORS, CABLES, SPLICING DEVICES AND CONNECTORSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. This section of the Specifications covers all of the electrical power, lighting, and control power (line voltage) conductors, but does not include communications, data or signal system conductors, which are specified separately in these specifications.
- C. All conduits installed without conductors shall have a 200 lb. test nylon string installed for future use, tied off securely at each end.
- D. No more than 40% conduit fill permitted for any conduit system, including video, intercom, data, voice, power or other signal circuits unless specifically indicated otherwise on the plans.
- E. No more than seven conductors (six current-carrying and one ground) shall be installed in a conduit except for switch legs and travelers in multi-point switching arrangements. Multi-wire branch circuits with a shared neutral are not allowed.
- F. If multiple circuits are pulled in a single homerun, a dedicated neutral shall be provided for each phase conductor. In these cases, a maximum of seven conductors (six current carrying and one ground) are permitted in a single conduit. Conductors shall be derated per NEC.
- G. Intentional or unintentional painting of exposed low-voltage and/or line-voltage cabling is prohibited. The contractor shall ensure that exposed cabling is adequately protected from direct painting or overspray whether painting is required within the electrical specifications or required by other disciplines/trades. The contractor shall review the painting requirements for all disciplines and shall provide cabling protection as required. Where exposed cabling is being installed in exposed ceiling or wall spaces that are required to be painted, the contractor shall provide alternate options for cable colors and shall provide submittals for such cabling to engineer for approval.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordinate paragraph below with qualification requirements in Division 01 Section "Quality Requirements" and as supplemented in "Quality Assurance" Article.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. Alpha Wire Company.
 - 3. American Insulated Wire Corp.; a Leviton Company.
 - 4. Belden Inc.
 - 5. Cerro Wire LLC.
 - 6. Encore Wire Corporation.
 - 7. General Cable Technologies Corporation.
 - 8. General Cable Corporation.
 - 9. Senator Wire & Cable Company.
 - 10. Southwire Company.
- B. All conductors shall be 98% conductive annealed copper unless otherwise noted, UL listed and labeled. Comply with ANSI/NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation:
 - 1. Comply with ANSI/NEMA WC 70/ICEA S-95-658.
 - 2. Lighting and receptacle branch circuits shall be Type THW, THHN or THWN insulation.
 - 3. All feeders shall be Type THW or THWN of the size as shown on the Contract Drawings.
 - 4. THHN wiring shall only be installed in overhead, dry or damp locations.
 - 5. THWN OR THW wiring shall be used for all circuits pulled in underground or other wet locations.
- D. Conductor sizes indicated on drawings are based upon 75 degree C rating.

- E. Minimum branch circuit or feeder size shall be not less than #10 AWG copper wire or of the sizes shown on the drawings.
- F. All Conductors shall be stranded.
- G. Designer Note: Remove sentence requiring plenum fire alarm cable if installed in conduit. Remove sentence requiring conduit if exposed plenum cable is acceptable.
- H. Conductors for fire alarm wiring shall be stranded and in full compliance with NEC 760. All fire alarm conductors shall be installed within conduit and enclosed junction boxes. Exposed cabling in air plenums shall be rated for plenum installation.
- I. All wire on the project shall be new, in good condition, and shall be delivered in standard coils or reels.
- J. The color of the wire shall be selected to conform to Section 210-5 of the latest edition of the National Electrical Code. Power conductors of all sizes shall follow the color coding scheme listed under PART 3, IDENTIFICATION below.
- K. Conductors used for motor connections and connections to vibrating or oscillating equipment shall be extra flexible.
- L. Conductors for main ground from neutral bus, equipment grounding bus, building steel, grounding grid and main cold water pipe connection shall be bare copper.
- M. All conductors shall be identified by color code and by means of labels placed on conductors in all junction boxes and at each terminal point with Brady, Ideal, T & B or approved equivalent labels indicating source, circuit number or terminal number.
- N. All feeders and branch circuits shall be installed and sized for a maximum 2% voltage drop. As calculated using 80% of the supply breaker rating as the load. Adjust conductors and conduit size accordingly for actual field installed conditions.
- O. For 120VAC, 20AMP branch circuits:
 - 1. #10 AWG when run is 50 feet or less;
 - 2. #10 AWG when run is between 50 feet and 100 feet;
 - 3. #8 AWG when run is more than 100 feet.
- P. No aluminum conductors shall be used.
Designer Note: Choose one of the following three options (*) for MC cable:
Designer Note: Keep P. for projects where MC cable is not desired.
- Q. MC cable and AC cable shall not be permitted.
- R. MC cable is acceptable for the following applications:
 - 1. Feeders for lighting fixture whips and for branch circuits concealed in walls and partitions only. Locate junction box and convert to single conductors in rigid raceway within the same room as where the cable enters/exits the wall.
 - 2. Use only for single-circuit cable (i.e. two wire plus ground). For devices in the same wall connected to different circuits, install separate single circuit cable for each circuit.
 - 3. The MC cable length for power circuits shall be limited to 30' from the junction box to the wiring device located in the wall. If the circuit continues outside the wall, the circuit must immediately transition to conduit.
 - 4. The MC cable length for lighting circuits shall be limited to 30' from the junction box to the first fixture and from that point only those fixtures above the enclosed space/room shall be served by this HCF circuit.
- S. MC cable is not acceptable for the following applications:

1. Homeruns to Panelboards.
2. Branch circuits serving Essential Electrical System (Emergency & Standby) loads; including Life Safety branch, Critical branch and equipment emergency system.
3. Branch circuits serving HVAC, elevator/escalator, medical and kitchen equipment loads.
4. Within mechanical, electrical or telecommunication equipment rooms.
5. Exposed Branch Circuits within areas that do not have a ceiling (i.e. open to structure).
6. Wet locations.

2.2 SPLICING DEVICES & CONNECTORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. 3M; Electrical Products Division.
 2. AFC Cable Systems, Inc.
 3. Burndy
 4. Gardner Bender.
 5. Hubbell Power Systems, Inc.
 6. Ideal Industries, Inc.
 7. ILSCO.
 8. NSi Industries LLC.
 9. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 10. Reliable
 11. T&B
 12. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Splicing devices for use on #10 AWG and smaller conductors shall be pressure type such as T&B "Sta-Kon".
- D. Wire nuts shall be spring pressure type, insulation 600V, 105°C insulation, up to #8 AWG. Greater than #6 AWG shall be a compression type connection, 600V insulation, cold shrink tubing, taped to restore full insulation value of the wire being spliced.
- E. Pressure crimp-applied ring type (or fork with upturned ends) terminations shall be employed on motor and equipment terminals where such terminals are provided on motor and equipment leads or on all stranded wire terminations using #10 AWG or smaller conductors.
- F. Splices, where necessary, shall be made with hydraulically-set "Hy-press" or equivalent crimped connectors. All splices shall be insulated to the full value of the wiring insulation using a cold-shrink kit or the equivalent in built-up materials.
- G. Large connectors (lugs) at terminals shall be mechanical type, hex-head socket or crimp-on style, installed per the manufacturer's recommendations.
- H. Underground connections made between bare ground wires or to ground rods shall be exothermically welded, "Cadweld" or equivalent.
- I. No aluminum splicing devices or connectors shall be used.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION MATERIAL APPLICATIONS

- A. Feeders and Branch Circuits: Copper. Solid for #10 AWG and smaller; stranded for # 8 AWG and larger.

- B. Conductors used for motor connections and connections to vibrating or oscillating equipment shall be extra flexible stranded.
- C. Conductors used for theatrical lighting branch cables shall be extra flexible stranded.
- D. Lighting and receptacle branch circuits shall be Type THW, THHN or THWN insulation.
- E. All feeders shall be Type THW or THWN of the size as shown on the Contract Drawings.
- F. THHN wiring shall only be installed in overhead, dry or damp locations.
- G. THWN or THW wiring shall be used for all circuits pulled in underground or other wet locations.
- H. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- I. Motor Connections shall use connection lugs with motor stub splice insulators.
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.2 INSTALLATION

- A. Clean out raceway system before pulling conductors.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. The pulling of all wires and cable on this project shall be performed in strict compliance with applicable sections of the National Electrical Code. No conductor entering or leaving a cabinet or box shall be deflected in such a manner as to cause excess pressure on the conductor insulation. Conductors shall only be installed after insulating bushings are in place.
- E. The radius of bending of conductors shall be not less than eighteen times the outside diameter of the conductor insulation or more, if recommended by the manufacturer.
- F. Conductors installed within environmental air plenums shall be per NEC. Article 800 and other applicable codes, with FEP-type insulation or an approved equivalent. Also provide plenum-rated tie-wraps where plastic straps or other supports, etc., are installed in plenum areas.
- G. Where indicated, systems and control conductors that are installed exposed shall not be routed across ceilings or ductwork. They shall be held up against building structure or against permanent support members. They shall be installed in such a manner that they do not interfere with the access to or operation of equipment or removal of ceiling tiles. Nylon tie-wraps shall be installed in such a manner so as to bundle conductors neatly, allowing runouts of single conductors or groups to drop down to equipment served. Install grommeting where dropping out of trays or into panels or service columns. Install sleeves with bushings where penetrating partitions. Firestop sleeves with approved material. Do not penetrate firewalls if so indicated on plans. Refer to the drawings for support requirements and details on routing exposed communications conductors.
- H. Conductors for isolated power systems shall be installed in as short a run of conduit as practicable. No pulling soap shall be used on conductors in isolated power systems.
- I. Where conductors are installed in industrial facilities, they shall be per JIC standards.
- J. Maximum permissible pulling tensions, as recommended by the manufacturer for any given type of cable or wire installed shall not be exceeded. Utilize special remote readout equipment to ensure compliance. Use particular caution when installing twisted pair data cable or fiber optic cables -- forces permitted for pulling in are typically very low for these cable types.

- K. All cables and wiring, regardless of voltage, installed in manholes or cable vaults shall be routed in such a manner to provide a minimum of 6 feet of slack cable for future splicing. Install cables along walls by utilizing the longer route from entry to exit. If both routes are symmetrical, provide a loop of cable secured to wall. All cables shall be tied to insulated cable supports on wall-mounted racks, spaced a maximum of three feet apart.
- L. Where multi-wire branch circuits are allowed on the drawings, the phases and neutral shall be wire-tied together in the panelboard and in all pull boxes.

3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
- C. Wiring at Outlets: Install conductors at each outlet with at least 12 inches of slack.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Perform insulation resistance (megger) testing for all bus duct and feeders in accordance with NETA ATS. Testing may be witnessed by the Engineer and/or Commissioning agent. Schedule all tests with Architect with ample notice.
 - 3. Megger tests shall be performed at a DC voltage of 1,000 volts for 600 volt rated equipment, and at a DC voltage of 500 volts for 120-300 volt rated equipment. Minimum acceptable (temperature corrected) resistance is 25 megaohms for 120-300 volt rated equipment and 100 megaohms for 600 volt rated equipment and wiring.
 - 4. Test instruments shall be calibrated to national standards within the last 12 months.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors #3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - 2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- E. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

- F. Cables will be considered defective if they do not pass tests and inspections. Remove and replace malfunctioning units and retest as specified above.
- G. Submit test results to Architect and Engineer for approval

3.5 IDENTIFICATION

- A. Color coding distribution voltage conductors, 600 volts or less
- B. Conductors, in all sizes of cable, shall have continuous solid insulation color(s) from the manufacturer. Taped ends shall not be acceptable.
 - 1. Conductors shall be color coded as follows:
 - a. 120/208 Volt Conductors
 - 1) Phase A: Black
 - 2) Phase B: Red
 - 3) Phase C: Blue
 - 4) Neutral: White
 - 5) Ground: Green
 - 6) Isolated Ground: Green/Yellow
 - b. 277/480 Volt Conductors
 - 1) Phase A: Brown
 - 2) Phase B: Orange
 - 3) Phase C: Yellow
 - 4) Neutral: Gray or White with Brown tracer
 - 5) Ground: Green
 - 6) Isolated Ground: Green/Yellow
 - c. Isolated Power Conductors (Type XLP or XHHN)
 - 1) Phase A - Brown
 - 2) Phase B - Orange
 - 3) Phase C - Yellow
 - 4) Neutral - White with brown tracer stripe
 - 5) Note: Provide each phase with tracer color other than white, green, or gray.
 - d. Note: Further identify isolated power conductors with 1/2" wide purple tape at all terminations and junctions.
 - 2. Fire Alarm Wiring: Red
 - 3. Signal voltage wiring color coding shall be consistent throughout the project and shall match existing equipment and standards where applicable. Color coding for each system shall be unique.
 - 4. Conductors within enclosures that may be energized when enclosure disconnect is off - yellow, or taped with 1/2" yellow tape every 6" of length, inside enclosure. Provide lamacoid plate warning sign on front of enclosure where this condition occurs.
 - 5. DC Wiring: Positive: Light Blue
Negative: Dark Blue
- C. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Foundation steel electrodes.
 - 3. Ground bonding common with lightning protection system.
 - 4. Grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems.
 - 5. Building Ground Rings (counterpoise systems)
- B. All metallic conduit, raceways, cable trays, wireways, supports, cabinets and equipment shall be grounded in accordance with the latest National Electrical Code, as shown on the Contract Drawings and in accord with the requirements of the local authority having jurisdiction, as applicable.
- C. The size of the equipment grounding conductors, grounding electrode conductors and service grounding conductors shall be not less than that given in Article No. 250 of the National Electrical Code, and/or as shown on the Contract Drawings. Where ungrounded conductor sizes are increased to minimize voltage drop, grounded conductor sizes shall be increased in the proper proportion.
- D. Grounding bus and non-current carrying metallic parts of all equipment and raceway systems shall be securely grounded by connection to common ground.
- E. The service entrance main ground bus shall also be connected to the main cold metallic water pipe within three feet of where it enters the building, on both the house and street sides of the main shut-off valve with a properly sized bonding jumper. A properly sized bonding jumper shall also be provided to the frame of any steel structure utilized in the construction. The steel frame of the building (if any) shall be made electrically continuous.
- F. All ground electrode systems shall be installed in accordance with manufacturer's recommendations, UL listings, ANSI standards, National Electrical Code and National Electrical Safety Code.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including the following:
 - 1. Grounding Systems
 - 2. Ground Rods
 - 3. Ground Wires
 - 4. Connectors and Fasteners
 - 5. Bonding Materials

1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports. Provide the following test reports:
 - 1. Bond resistance test
 - 2. Ground resistance tests
 - 3. Ground isolation test
 - 4. Continuity isolation test

1.5 CLOSEOUT DOCUMENTS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
- B. In addition to items specified in Section 260501 "CLOSEOUT DOCUMENTS," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features at building master ground bus and electrodes based on NFPA 70B.
 - 2. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 3. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Listing and labeling: Provide products specified in this Section that are listed and labeled.
- D. Comply with NECA's "Standard of Installation."

1.7 SYSTEM COMMISSIONING

- A. Section 019113 requires the engagement of a Commissioning Authority to document the completion of the Mechanical, Fire Protection, Plumbing, Electrical, Electronic Safety and Security, and associated Control Systems for the project. Section 019113 defines the roles and responsibilities of each member of the commissioning team.
- B. Comply with the requirements of Section 019113 for the commissioning of the various building systems.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by one of the following:

1. Erico
2. ILSCO
3. Cadweld
4. Burndy
5. Therm-O-Weld
6. T&B
7. O.A. Co.
8. Lyncole XIT Grounding
9. Superior Grounding Systems
10. LEC Inc

2.3 CONDUCTORS

- A. Comply with Specification Section 260519, LOW-VOLTAGE ELECTRICAL POWER, CONDUCTORS, CABLES, SPLICING DEVICES AND CONNECTORS.
- B. Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- C. Ground wires and cables shall be of the AWG sizes shown on the Contract Drawings or shall be sized in accordance with the prevailing codes. All ground wires and cables shall be copper.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
1. Pipe connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar per EIA/TIA standards.
- E. All grounding fittings shall be heavy cast bronze or copper of the mechanical type except for underground installations or interconnection of grounding grid to cable, columns and ground electrodes, which shall be thermically welded type as manufactured by Cadweld, Burndy Co., Therm-O-Weld, or approved equivalent.

2.5 GROUND RODS

- A. Copper-clad steel; 3/4 inch in diameter by 10 feet long, molecularly bonded copper to high-strength steel core, copper thickness per UL/ANSI. Ensure ground rods are clean and smooth and have a cone-shaped point. Ensure ground rods are die-stamped near the top with the name and trademark of the manufacturer and the length in feet.

2.6 CHEMICAL GROUNDING ELECTRODE SYSTEM:

- A. The ground electrode system shall be as specified herein. The system shall not require maintenance throughout the expected life span of the materials.
- B. Ground system shall be an electrolytic rod type, as manufactured by Lyncole XIT Grounding, Superior Grounding Systems, LEC, Inc. (Chem-Rod), or approved equivalent. Electrode(s) shall be placed as shown on the plans, installed exactly per manufacturer's recommendations. Electrodes shall be installed

vertically, 12 feet of overall length (or length as indicated), set in a drilled hole and backfilled per manufacturer's instructions with a special clay slurry surrounding the rod. Provide a concrete protection box with cast iron grate for the top of the rod termination. Ground system shall be per the following:

1. Manufacturer: Lyncole XIT Grounding (or approved equivalent).
2. Source: Lyncole XIT Grounding, 22412 S. Normandie Ave., Torrance, CA 90502 1-800-962-2610
3. Shaft Configuration: Straight.
4. Shaft Length: 12 feet (or as otherwise indicated).
5. Listings: U.L.-467J, ANSI 633.8.
6. Material: Type K Copper.
7. Construction: Hollow tube, 2.125" O.D., chemical filled with non-hazardous metallic salts.
8. Weight 3.5 lbs. per foot of length, nominal.
9. Ground Wire Termination: Exothermic ("Cadweld" by Contractor) connection to 4/0 conductor, with U-bolt with pressure plate provided as test point.
10. Average Life Expectancy: 25 Years.
11. Model Number: K2-(length)CS.
12. Provide grounding system with the following components: protective box, backfill material. Box to be concrete with cast iron, tamper-resistant lid, backfill to be "Bentonite" clay.

C. Installation of Pipe Ground System:

1. Pipe ground systems shall be installed exactly as required by the system manufacturer. The Contractor shall be diligent to observe the excavation, sealing tape removal, slurry backfill and all other critical requirements.
2. Note: NEVER USE SAND OR ORDINARY EARTH AS A BACKFILL MATERIAL
3. Pipe grounding system shall be warranted unconditionally by the Contractor for a period of one year from the date of substantial completion.

2.7 TELECOMMUNICATION CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Chatsworth Products, Inc.
 2. Harger Lightning and Grounding.
 3. Panduit Corp.
 4. Tyco Electronics Corp.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 1. Electroplated tinned copper, C and H shaped.
- D. Busbar Rack and Tray Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- F. Cable Tray Grounding Jumper:

1. Not smaller than #2 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. Attach with grounding screw or connector provided by cable tray manufacturer.

2.8 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Chatsworth Products, Inc.
 2. Harger Lightning and Grounding.
 3. Panduit Corp.
 4. Tyco Electronics Corp.
- B. TMGB and TGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper in cross section and length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-B.
 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar per EIA/TIA standards.
 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with four (2) rows of 9/32-inch holes spaced 1-1/8 inches apart. Minimum length of 18" or as indicated on Contract Drawings
 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600V. Lexan or PVC, impulse tested at 5000 V.
 4. Predrilling shall be with holes for use with lugs specified in this Section.
 5. Mounting Hardware: Stand-off brackets that provide at least a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 6. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- D. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 GENERAL

- A. All metallic conduit, raceways, wireways, supports, cabinets and equipment shall be grounded in accordance with the latest issue of the National Electrical Code, as shown on the Contract Drawings and in accord with the requirements of the local authority having jurisdiction, as applicable.
- B. The size of the equipment shall be not less than that given in Article No. 250 of the National Electrical Code, and/or as shown on the Contract Drawings.
- C. Grounding bus and non-current carrying metallic parts of all equipment and raceway systems shall be securely grounded by connection to common ground.
- D. All outlet, junction and pull boxes shall be grounded with pigtail to the equipment grounding conductor.

3.2 APPLICATIONS

- A. Conductors: Install solid conductor for #10 AWG and smaller, and stranded conductors for #8 AWG and larger unless otherwise indicated.

- B. Underground Grounding Conductors: Install bare copper conductor, #3/0 AWG minimum or as indicated on drawings, whichever is larger.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
 - C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe.
 - D. Grounding Bus: Install in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 18 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
 - E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- 3.3 GROUNDING AT THE SERVICE
- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral bus and ground bus.
- 3.4 GROUNDING SEPARATELY DERIVED SYSTEMS
- A. Where NEC requires grounding for a separately derived system, ground according to NEC.
 - B. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.
- 3.5 COUNTERPOISE
- A. Provide a ground ring conductor (counterpoise) extending around the perimeter of the building. Bury counterpoise not less than 30 inches below grade and 10 feet from building foundation. Use tinned-copper conductor not less than #2/0 AWG for counterpoise and for the tap to building steel. The counterpoise conductor trench shall be filled with 1" of Erico Ground Enhancement Material (GEM) above and below the conductor. Install per Erico GEM Instruction Sheet IP7945_B.
 - B. Ground the steel framework of the building with a ground rod at every corner column and at every other exterior column. The ground rods shall be located in the counterpoise trench and shall be attached to the counterpoise with a type GY (conductor-to-rod) connection by Erico and an XB (conductor-to-conductor) connection by Erico. The top of the ground rod shall not be less than 24" below grade. The conductor that attaches the rod to the counterpoise shall run continuous to the base of the structural steel column and welded to the column.
- 3.6 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS
- A. Comply with IEEE C2 grounding requirements.
 - B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide #1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with #4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.7 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Busway Supply Circuits
 - 8. Computer and Rack-Mounted Electronic Equipment Circuits.
- B. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
 - 1. For telephone, alarm, voice and data, and other communication equipment, provide #4/0 minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-18-inch grounding bus.
 - 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Install a copper-clad steel, 3/4 inch in diameter by 10 feet long, ground rod and a separate insulated equipment grounding conductor at each pole in addition to grounding conductor installed with branch-circuit conductors.

3.8 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. All grounding conductors shall be protected from mechanical injury and shall be rigidly supported. Where ground conductors are run through flexible conduit and through panelboard switchboard or motor control center feeders, they shall be securely bonded to such conduit thru the use of grounding bushings at the entrance and exit. All connection of equipment shall be made with an approved type of solderless connection and same shall be bolted or clamped to equipment or conduit.
- C. Equipment ground connections to GFI circuit breakers shall be carried and bonded to each outlet on the circuit. Provide a separate equipment grounding conductor with green color insulation.
- D. Equipment grounding conductors shall be routed to lighting fixtures, devices, receptacles, electric heaters, furnace and other equipment. Equipment grounding conductors shall be green.
- E. Resistance to the grounding at the service entrance equipment shall be in accordance with the NEC for style of construction and shall not exceed five ohms as measured by the described testing method.
- F. All circuits shall have a grounding conductor.
- G. When grounding systems are completely installed and all grading in the area of the service grounding electrode has been completed up to finish elevations, perform a fall-of potential or other approved test to determine actual system resistance to earth. Report results to the Engineer in writing. Refer to testing provisions in this section of specifications.
- H. Where separately-derived systems are utilized as part of the power distribution network, the neutral leg of the secondary side of generators, transformers, etc., shall be connected to a grounding electrode in accordance with the manufacturer's recommendations.
- I. The Contractor shall ensure that the ground return path thru building structural steel or other means is electrically continuous back to the service grounding electrode and is of adequate capacity and impedance to carry the maximum expected fault or other current. Where no electrically continuous steel building frame is available, the Contractor shall provide a properly sized ground bar and ground conductor routed back to the main facility ground bus.
- J. Where a building's steel frame is made electrically discontinuous by masonry breaks (as at firewalls, etc.), the Contractor shall provide an accessible thermally welded bonding jumper of #500Kcmil copper to bond the building steel frame sections together, making the entire steel frame electrically continuous. The installation of these bonding jumpers shall be reviewed by the Engineer prior to their being covered by construction.
- K. Where lightning protection systems are utilized on the work, their electrodes and conductors shall be electrically segregated from the building service ground, except where connections to structural elements are required for the proper installation of these systems. Lightning protection grounds shall only be utilized for lightning grounding applications, in accord with UL and manufacturer's recommendations.
- L. Grounding connections shall never be made to fire protection, natural gas, flammable gas or liquid fuel piping, except where specifically indicated on the plans.
- M. Where dielectric fittings are utilized in piping systems, the piping system shall not be utilized as a ground path. Bonding jumpers shall not be utilized to bridge over such fittings. Piping systems shall not be utilized as ground paths except where specifically required by codes in the case of water piping.
- N. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- O. At all metallic outlet, junction and pull boxes, bond the equipment grounding conductor to the box.

- P. Ground Rods: Drive rods until tops are 12 inches below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
 3. Provide well access for testing at one (1) rod.
- Q. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- R. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- S. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- T. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- U. Grounding for Steel Building Structure: Provide a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- V. Concrete-Encased Grounding Electrode (Ufer Ground): Provide and fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than #4 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- W. Perform ground testing, log results, and provide reports of test points, test values, and procedure as required by engineer and/or local authority having jurisdiction. All systems shall be grounded to maintain leakage current below levels required by applicable codes and standards.

- X. Grounding Busbars:
1. Install busbars horizontally, on insulated spacers 4 inches minimum from wall, 72 inches above finished floor unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- 3.9 TELECOMMUNICATIONS CONNECTIONS: Electrical Contractor shall perform the following work whether equipment and devices are provided by the Owner, Owner's Vendor or by the Electrical Contractor:
- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than #6 AWG.
 - B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
 - C. Primary Protector: Bond to the TMGB with insulated bonding conductor.
 - D. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor shall be as indicated on the drawings.
 - E. Telecommunications Enclosures and Equipment Racks: electrical Contractor shall bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar. Bond the equipment grounding busbar to the TGB with #2 AWG bonding conductors.
 - F. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-C.1 and TIA/EIA-568-C.2 when grounding screened, balanced, twisted-pair cables.
 - G. Rack- and Cabinet-Mounted Equipment:
 - H. Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
 1. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.
- 3.10 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - B. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by four point fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - C. Grounding system will be considered defective if it does not pass tests and inspections.
 - D. Prepare test and inspection reports.
 - E. Report measured ground resistances:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.
 - 5. Substations and Pad-Mounted Equipment shall be 5 ohms or less.
 - 6. Manhole Grounds shall be 10 ohms or less.
 - F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
- 3.11 SERVICE GROUND TESTING PROCEDURE
- A. The actual resistance to earth of the service grounding electrode shall be measured by the Contractor via the fall-of-potential method. This testing shall be accomplished after the grounding electrode has been completely installed and the finished grade is achieved.
 - B. The results of the testing shall be summarized in a written report by the Contractor, which shall be forwarded to the Engineer for review. The report shall also be included with the operation and maintenance manuals for the Owner's information and future reference. This report is to also contain a detailed description and illustrations of the testing procedure, along with the name and model number of the testing instrument(s).
 - C. For the actual testing, the Contractor shall follow the procedures outlined below. A self-contained instrument such as a "Megger" or "Ground OHMMETER" shall be used that is designed to eliminate the influence of stray current effects on the accuracy of the measurements.
 - D. Connect one side of the instrument to the grounding electrode conductor where it connects to the facility main ground bus (point C1). Disconnect and isolate the grounding electrode conductor for the test.
 - E. Drive a copperweld reference electrode probe (point C2) into earth between 300 and 500 feet away from C1 and connect to measurement instrument.
 - F. Drive the movable grounding probe (C3) into earth at ten equally spaced intervals, in a straight line between C1 and C2 points and note the $E/I=R$ resistance readings on a graph at each point.
 - G. The resistance measurements in OHMS taken from the flat part of the curve shall be averaged to determine the true grounding electrode resistance to earth.
 - H. At completion of testing, remove reference electrode C2 and all temporary wiring and connections.
 - I. If actual measurements of grounding electrode indicate a resistance greater than five OHMS, contact the Engineer for instructions. If deemed necessary by the Engineer, additional electrodes shall be placed and the measurement process repeated until the desired ground potential is achieved.
 - J. Record results for each step in the testing process and include a full report in close-out documentation.
- 3.12 FUNCTIONAL PERFORMANCE TESTS

- A. System functional performance testing is part of the Commissioning Process as specified in Section 019113. Functional performance testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section Includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
 - 3. Isolation pads.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit
- C. LFMC: Liquid-tight flexible metal conduit
- D. GRS: Galvanized rigid steel conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze hangers. Include Product Data for components.
 2. Steel slotted channel systems. Include Product Data for components.
 3. Nonmetallic slotted channel systems. Include Product Data for components.
 4. Equipment supports.
 5. Concrete Based for Equipment.
 6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 7. Delegated-Design Submittal: For hangers and supports for electrical systems.
 8. Include design calculations and details of trapeze hangers.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Structural members to which hangers and supports will be attached.
 3. Size and location of initial access modules for acoustical tile.
 4. Items penetrating finished ceiling, including the following:
 5. Lighting fixtures.
 6. Air outlets and inlets.
 7. Speakers.
 8. Sprinklers.
 9. Access panels.
 10. Projectors.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.9 SYSTEM COMMISSIONING

- A. Section 019113 requires the engagement of a Commissioning Authority to document the completion of the Mechanical, Fire Protection, Plumbing, Electrical, Electronic Safety and Security, and associated Control Systems for the project. Section 019113 defines the roles and responsibilities of each member of the commissioning team.
- B. Comply with the requirements of Section 019113 for the commissioning of the various building systems.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. Thomas & Betts Corporation.
 - e. Unistrut; Tyco International, Ltd.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Device Box Mounting Brackets: Factory-fabricated sheet steel brackets for support of device boxes adjacent to or between studs.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
- F. Through-Stud Cable and Raceway Support Clips: Factory-fabricated spring steel clip for cables or raceways where run horizontally through metal studs.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
- G. Roof-mounted Raceway Support Blocking: Factory-fabricated support blocking for use under roof-mounted raceways. Wedge-shaped blocking constructed of 100% recycled UV-resistant Rubber with integral galvanized steel strut to accept raceway support clips.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Cooper B-Line C-Port series components or a comparable product by one of the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
- H. Tee Bar Grid Box Hanger: Factory-fabricated metal electrical box hanger for supporting boxes at locations between ceiling system t-grid components. Height adjustable for various electrical box depths. Attached to ceiling tee bar with screws or integral clamp for stability. Includes tab for independent support wire attachment.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.

- I. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- J. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, or steel with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Solid, threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.3 VIBRATION ISOLATION PADS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Korfund Maxi-Flex Pads or a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.

6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NFPA 70, NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except where requirements of this Section are more stringent.
- B. Maximum Horizontal and Vertical Support Spacing for Raceway(s): Space supports for EMT and GRS as required by NFPA 70.
- C. Minimum Hanger Rod Size for Raceway Supports: Minimum rod size shall be 1/4 inch in diameter.
- D. Single Raceways:
 1. For Raceways 1-1/4-inch and smaller: Install adjustable steel band hanger suspended on threaded rod.
 2. For Raceways larger than 1-1/4-inch: Install trapeze-type supports fabricated with steel slotted support system suspended on threaded rods. Size trapeze members, including the suspension rods, based on the support required for the size, and loaded weight of the conduits.
 - a. Secure raceway or cable to support with two-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.
- E. Multiple Raceways: Install trapeze-type supports fabricated with steel slotted support system suspended on threaded rods, where multiple raceways are run vertically or horizontally at the same elevations. Size trapeze members, including the suspension rods, based on the support required for the number, size, and loaded weight of the conduits. Space them as required for the smallest conduit to be supported. Size so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SUPPORT INSTALLATION

- A. Comply with NFPA 70, NECA 1 and NECA 101 for installation requirements except where requirements of this Article are more stringent.

- B. Fasten junction, pull and devices boxes securely to the building construction, independent of raceway system.
- C. Install Device Box Mounting Brackets supported between two studs. All device boxes shall attached to two studs, device box stabilizers shall not be acceptable.
- D. Install Through-Stud Cable and Raceway Support Clips where cables or raceways run horizontally through metal studs.
- E. Install Tee Bar Grid Box Hanger supported between two ceiling grid tee bars where devices boxes are located flush in recessed suspended ceilings.
 - 1. Install at least one independent support rod from box hanger to structure.
- F. Install Roof-mounted Raceway Support Blocking where raceways run on across roofing.
 - 1. Coordinate installation of roof supports with items specified in Division 07 Section "Roof Accessories." Provide products compatible with rooftop materials included in the Work.
- G. Provide minimum of two lock nuts per threaded support rod except where lock nut tightens against a threaded socket, one locknut may be used.
- H. Support raceways at a distance above suspended ceilings to permit removal of ceiling panels and luminaires.
- I. Locate raceways so as not to hinder access to mechanical equipment.
- J. Do not secure conductors, raceways, or supports to suspended ceiling hanger rods or wires.
- K. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- L. Mounting and Anchorage of Surface-Mounted or Recessed-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts. Where support anchors are required, establish their type and locate in concrete construction before concrete is poured, if possible. Fit each hanger rod with a nut at its upper end, and set nut in a universal concrete insert in the form. Where supported weight exceeds holding strength of a single insert, pass rods through top slot of inserts and interlock with reinforcing steel. Also, where particularly heavy loads are to be supported, suspend hanger rod or rods from a structural angle spanning two or more inserts and securely bolted thereto to distribute the weight.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
 - 6. To Light Steel: Sheet metal screws.
 - 7. For Surface-Mounted Items on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to structure by means that meet seismic-restraint strength and anchorage requirements. Attachment to gypsum wall board is not acceptable as sole support means; slotted-channel rack solidly attached to structure or light-gauge metal framing at both ends is required.
 - 8. For Recessed-Mounted Items in Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes,

transformers, and other devices to intermediate light-gauge metal framing members on each side of device or provide slotted-channel racks within hollow wall attached to structure by means that meet seismic-restraint strength and anchorage requirements. Attachment to gypsum wall board is not acceptable as sole support means.

- M. Do not support any items (equipment, piping, conduit, etc.) exceeding 2 inches in diameter from the bottom of slabs. Where intermediate supports are required between structural members, use slotted steel channels support systems attached to beams or joists in order to avoid attachment to slabs.
- N. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars. Verify reinforcing locations with Structural Engineer. X-Ray existing concrete structures as required.

3.4 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.5 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 3 inches larger in all directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.6 PAINTING

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260533 - RACEWAYS AND FITTINGS FOR ELECTRICAL SYSTEMSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. This section is intended to specify the raceways, conduit, conduit fittings, hangers, junction boxes, splice boxes, specialties and related items necessary to complete the work as shown on the drawings and specified herein.
- B. This section specifies basic materials and methods and is a part of each Division 26, 27 and 28 Sections that implies or refers to electrical raceways specified therein.
- C. The types of raceways specified in this section include the following:
 - 1. Steel electrical metallic tubing (EMT)
 - 2. Galvanized rigid steel conduit (GRS or RMC)
 - 3. Intermediate metal conduit (IMC)
 - 4. Rigid aluminum conduit (RAC)
 - 5. Flexible metal conduit (FMC)
 - 6. Liquid-tight flexible metal conduit (LFMC)
 - 7. Rigid nonmetallic conduit (RNC)
 - 8. Surface metal raceway (SMR)
 - 9. Metal wireways and auxiliary gutters.
- D. All raceways, as listed above and otherwise specified herein shall be provided in compliance with latest editions of all applicable UL, NEMA, NEC and ANSI standards. All conduit, raceways and fittings shall be Underwriters Laboratories listed and labeled, or bear the listing of an agency acceptable to the local authority having jurisdiction.
- E. Conduit and raceways, as well as supporting inserts in contact with or enclosed in concrete shall comply with the latest edition of all ACI standards and the equipment manufacturer's recommendations for such work.
- F. The decision of the Engineer shall be final and binding in any case where a question or inquiry arises regarding the suitability of a particular installation or application of raceways, supports or materials, if other than outlined herein.
- G. Minimum size of conduit shall be 3/4" trade size for power and 1-1/4" trade size for voice/data/TV unless otherwise noted on the drawings. All conduit and raceways shall be sized for the number of conductors contained, in accord with the latest edition of the National Electrical Code or any other applicable standards.

- H. The installer of raceway systems shall avoid the use of dissimilar metals within raceway installations that would result in galvanic-action corrosion.
- I. PVC or other non-metallic conduit shall be rated for the maximum operating temperature that could be developed by the conductors it encloses, while in normal operation.
- J. All empty conduit installed anywhere shall have pull-strings installed for future cabling installation. Coordinate with vendors and provide extra pull-strings as required to ensure that when cabling is pulled, conduit will still have pull-strings installed for future use.
- K. Fire Alarm Cabling (open): All wiring which is exposed, concealed in walls, concealed above inaccessible ceilings, or otherwise inaccessible shall be installed within conduit and enclosed junction boxes. Provide a completely separate conduit system from power wiring or other raceway systems. All concealed conduit shall be manufactured red – no field painting will be accepted – and exposed conduit in finished spaces shall be painted to match adjacent finishes. Concealed cabling above accessible ceilings shall be an open cabling system ran in dedicated 2” J-hooks. Provide J-hooks above or below primary cabling paths used for other systems. Conduit stub-outs shall be run to these paths. Cabling shall be listed by the fire alarm system manufacturer for use with their system. Cabling shall be air-plenum-rated.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product data for raceways, conduits, outlet boxes, and wireways.
- B. Shop Drawings:
 - 1. Submit Shop Drawings of the complete metal surface raceway system.
 - 2. Shop Drawings shall include sizes and lengths of raceways, inside corners, outside corners, end caps, raceway cover spacing, grounding, branch circuiting and wiring including locations of service entrances, receptacle types and manufacturers, receptacle spacing, and receptacle labeling with proper voltage, phase, circuit and panelboard designations as indicated on the Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Anamet Electrical, Inc.
 - 4. Electri-Flex Company.

5. O-Z/Gedney; a brand of EGS Electrical Group.
 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
 7. Republic Conduit.
 8. Robroy Industries.
 9. Southwire Company.
 10. Thomas & Betts Corporation.
 11. Western Tube and Conduit Corporation.
 12. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. STEEL ELECTRICAL METALLIC TUBING
1. Electrical metallic tubing (EMT), of corrosion-resistant zinc coated cold rolled steel tubing shall be permitted for concealed installation in dry interior locations.
 2. EMT shall not be installed underground, in concrete slabs or where exposed to physical damage. EMT shall be permitted for exposed work in mechanical and electrical rooms and other exposed structure areas where not subjected to physical damage, as determined by the Engineer. All exposed conduit and fittings located within 8'-0" of finished floor shall be rigid steel with threaded connectors.
 3. Comply with ANSI C80.3 and UL 797.
 4. Connectors and couplings for EMT: Concrete- or rain-tight, compression type, made of zinc- or chromium-plated steel. Connectors shall have nylon insulating throats.
- D. GALVANIZED RIGID STEEL CONDUIT
1. Galvanized rigid steel conduit (GRS or RMC) shall have a zinc coating inside and outside by means of hot-dip galvanizing. Use only threaded fittings for GRS.
 2. Use GRS where subject to physical damage for exposed work in mechanical spaces, within factory or other industrial work areas, for exposed fit-up work on machinery, for exposed exterior damp or wet location work, in hazardous atmospheres, in exterior underground locations where installed beneath roadways, where ells occur in underground PVC conduits, or where turning out of concrete encased duct banks, and at other locations as specifically called out on the drawings.
 3. GRS shall be used for all building interior power wiring or cables of over 600 Volts.
 4. GRS shall be delivered with plastic protectors on the threads.
 5. GRS threads shall not have any coating which will reduce conductivity of the joint.
 6. Couplings, bends, elbows and fittings shall be subject to the same requirements as for the straight lengths.
 7. Comply with ANSI C80.1 and UL 6.
 8. "Kwik-Couple" type fittings are not acceptable.
 9. Use polyvinylchloride (PVC) coated rigid steel conduit in accordance with NEMA RN 1, Type 40 (40 mils thick) where underground and in corrosive areas.
- E. INTERMEDIATE METAL CONDUIT
1. Unless otherwise indicated on the drawings, intermediate metal conduit (IMC) may be used in any location in place of rigid galvanized steel conduit, as permitted by codes, and as approved by the Engineer.
 2. Manufactured in conformance with UL standards.
 3. Comply with ANSI C80.6 and UL 1242.
- F. RIGID ALUMINUM CONDUIT
1. Rigid aluminum conduit shall be permitted for installation indoors in dry locations only. Under no conditions shall it be cast into concrete slabs or pass thru construction where prolonged contact will degrade the aluminum.

2. All ells used in rigid aluminum conduit systems shall be rigid galvanized steel.
3. Manufactured in conformance with UL standards.
4. Comply with ANSI C80.5 and UL 6A.

G. FLEXIBLE METAL CONDUIT

1. Flexible metal conduit may be used only where required for connection to light fixtures, motors and other equipment subject to vibration. It shall be constructed of galvanized steel. It shall be installed with connectors designed for the purpose. All flexible metal conduit shall be installed as a single piece. No joints shall be installed. Flexible conduit shall not be used in wet or dusty locations or where exposed to oil, water or other damaging environments. An equipment grounding conductor or bonding jumper shall be used at all flexible conduit installations. Flexible metal conduit shall not be used in lengths over six feet for light fixture and three feet for other connections. Flexible metal conduit shall not be used in telephone, fire alarm, intercom, security, and other communication systems.
2. Comply with UL 1.

H. LIQUIDTIGHT FLEXIBLE METAL CONDUIT

1. Weatherproof flexible metal conduit shall be wound from a single strip of steel, neoprene covered, equivalent to "Liquatite" or "Sealtite" Type "UA". It shall be installed in such a manner that it will not tend to pull away from the connectors. Provide strain relief fittings equivalent to "Kellems" as required where subject to vibration. Flexible connections to motors in dusty areas shall be dust-tight, in areas exposed to the weather - weatherproof. Length shall not exceed 3' unless permitted by the Engineer.
2. Comply with UL 360.
3. Liquidtight type connectors: UL 14814A. Fittings: With nylon insulated throat.

I. RIGID NON-METALLIC CONDUIT

1. Polyvinylchloride (PVC) Conduit:
 - a. PVC conduit shall be Type II, in conformance with NEMA TC2 and the following:
 - 1) Schedule 40 and 80, high impact.
 - 2) Suitable for use with 90°C rated wire.
 - 3) Conform to UL Standard 651 and carry appropriate UL listing for above and below ground use.
2. Rigid non-metallic conduit shall be constructed of PVC, nominally schedule 40 weight. If installation will enclose utility company provided conductors, verify exact type required and install in accordance with their standards, where more stringent than this specification in normal building conditions.
3. Rigid non-metallic conduit may be used in exterior wet or damp locations where installed underslab or underground. It shall not be run in interior locations, except with special permission from the Engineer for use in corrosive environments, and then only if protected from physical damage. No rigid non-metallic conduit may be installed in environmental air plenums or cast into above-grade concrete slabs. No rigid nonmetallic conduit may be installed in locations where the ambient temperature might exceed the rating of the raceway.
4. Where rigid non-metallic conduit is placed underground, as for feeder circuits, secondaries or branch circuit runs and where ell is made upward thru a slab on grade, transition the turning ell and the riser to rigid steel conduit to a height of 6" above the concrete slab.
5. Flexible non-metallic conduit shall not be used, except by special permission, obtained in writing from the Engineer.
6. Provide equipment grounding conductors of copper, sized as required by codes, in all circuits installed in rigid nonmetallic raceways.
7. Manufactured in conformance with UL standards.

8. Comply with NEMA TC 2 and NEMA TC 3.

J. RACEWAY FITTINGS

1. Fixture whips shall be 1/2" flexible, with clamp-on steel fittings at each end, six foot maximum length, with insulated throat bushings at each end and bonding locknuts. Wiring thru fixture whips shall be #12 AWG, with #12 AWG ground bonded to outlet at source end.
2. Raceway fittings (or condulets) shall be of gray iron, malleable iron or heavy copper-free cast aluminum. They shall be furnished in proper configurations, avoiding excessive plugged openings. Any openings that are left shall be properly plugged. All coverplates shall be gasketed with neoprene or similar approved materials, rated for the environment. Wiring splices within are not permitted.
3. Where required, raceway fittings shall be provided in explosion-proof configurations rated for the atmosphere. Place conduit seal off fittings at each device in accord with applicable codes. Seal off fittings shall be packed with wadding, and poured with an approved non-shrink sealing compound.
4. Where conduit transitions in a run from a cold to a warm environment, (such as at a freezer, refrigerator or exterior wall) sealoff fittings shall be placed on the warm side immediately at the boundary to prevent migration of condensation within raceway systems.
5. Conduit bodies, junction boxes and fittings shall be dust tight and threaded for dusty areas, weatherproof for exterior locations and vapor tight for damp areas. Conduit fittings shall be as manufactured by Crouse Hinds, Appleton, Killark or approved equivalent. All surface mounted conduit fittings as with "FS", "FD", "GUB" Types etc., shall be provided with mounting hubs.
6. Where lighting fixtures, appliances or wiring devices are to be suspended from ceiling outlet boxes, they shall be provided with 3/4" rigid conduit pendants. Outlet boxes shall be malleable iron, provided with self-aligning covers with swivel ball joint and #14 gauge steel locking ring. Provide safety chain between building structure and ballast housing of light fixtures for all fixtures, appliances or devices greater than 10 lbs weight. Fixtures shall be installed plumb and level. Cover pendants shall be finished to match fixtures.
7. UL listed expansion/deflection fitting shall be provided at all locations where a raceway/conduit crosses a structural joint intended for expansion, contraction or deflection. Other approved means may be acceptable with permission of the Engineer. Provide copper ground bonding jumpers across expansion fittings.
8. Fittings for threaded raceways shall be tapered thread with all burrs removed, reamed ends and cutting oil wiped clean.
9. Fittings for EMT conduits 2-1/2" and smaller shall be of steel, compression type. Fittings for sizes larger than 2-1/2" shall be setscrew, with two setscrews each side. Conduit stops shall be formed in center of couplings. All EMT connectors and couplings shall be of formed steel construction. All connectors shall be insulated throat type.
10. Indentation or die-cast fittings shall not be permitted in any raceway system.
11. Compression type fittings shall be utilized for EMT conduit installed in damp or dusty locations, or where otherwise indicated.
12. All conduit fittings shall be securely tightened. All threaded fittings shall engage seven full threads. Fasteners shall be properly torqued to manufacturer's recommendations.
13. Comply with NEMA FB1 and UL 514B.

2.2 SURFACE MOUNTED METAL RACEWAY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Wiremold
 2. Istrol
 3. Hubbell
- B. Surface metal raceways shall only be provided where indicated on the drawings.

- C. System: Provide surface raceway systems for branch circuit and data network voice, video and other low-voltage wiring. Surface raceway system shall consist of raceway bases, covers, pre-divided raceway bases, dual covers, appropriate fittings and device mounting plates necessary for a complete installation.
- D. Surface metal raceways shall be constructed of code gauge corrosion-resistant galvanized steel or aluminum extrusions, and finished in an ivory, buff or grey color as selected by the Architect. Finishes shall be suitable for field painting, prepared by the installing Contractor as necessary.
- E. Surface metal raceways, where used as raceways only, shall be sized for the conductors indicated. Nominal minimum size of such raceways shall be equivalent to Wiremold Co. Series #700, or equivalent by Walkerdut, Isotrol or other approved manufacturer.
- F. Surface metal raceways to be furnished with integral receptacles shall have Simplex Nema 5-20R outlets spaced on centers as indicated on plans. These shall be Wiremold Co. #2200 Series or equivalent Walkerdut, Isotrol or other approved manufacturer.
- G. Surface Mounted Aluminum Raceways: ALDS4000 Dual Channel Aluminum Surface Raceway by The Wiremold Company.
 - 1. Material: Alloy 6063-T5 extruded aluminum; minimum thickness 0.050-inches.
 - 2. Finish: Satin, No. 204 clear anodized, 0.004-inch thick, Class R1 Mil-Spec.
 - 3. Device Cover Plates: Suitable to mount commercially available duplex devices, single 1.40" and 1.59" diameter receptacles. GFCI, surge receptacles and other rectangular faced devices, and voice and data jacks. Cover plates shall be removable using standard screwdriver without marring the finish.
- H. Surface metal raceways and all components and fittings shall be furnished by a single manufacturer, wherever practical. All trim and cover fittings, flush feed boxes, splices, outlet fittings, etc, necessary for a complete installation shall be provided by the installing contractor. These raceways shall be rigidly mounted with approved fasteners on not to exceed 24" centers in a run, or 6" from ends and on either side of a corner. Refer to plans for notations on exact types of these raceways and outlet configurations.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Mono-Systems, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70. Minimum of 14 gauge steel before finishes are applied.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireways of painted steel construction shall be corrosion-resistant, moisture and oil resistant where indicated or necessary. Wireways shall be furnished in nominal sizes of 2 ½ " X 2 ½ ", 4" X 4", 6" X 6", 8" X 8" or 12" X 12", as indicated on plans. Furnish with hinged covers on all runs and removable covers on all fittings, to allow a continuous unobstructed path for conductor installation. Provide knockouts on all runs, unless otherwise indicated or prohibited by codes.

- E. Provide wireways with hangers of same manufacturer, installed so as to allow unobstructed access to wireway interior. Install at not to exceed 8'-0" centers, closer as needed at fittings and turns. Use ¼ " rod hangers minimum for up to 4"X 4", 3/8 " rod minimum up to 8"X 8", ½ " rod minimum for 12" X 12".
- F. Wireway Covers: Furnish with continuous hinged covers on all runs and removable covers on all fittings, to allow a continuous unobstructed path for conductor installation.
- G. Finish: Manufacturer's standard enamel finish.

2.4 WALL DUCTS

- A. Where wall duct type raceways are indicated to be installed flush, they shall be a minimum 3 ½ " deep by 10" wide (or 18" width, as indicated), furnished with screw covers to overlap flange 1" on each side. Covers shall be furnished in nominal 3'-0" lengths. Provide fully grommeted openings or bushed nipples as needed in coverplates to pass cables thru. Where indicated or required, provide transition fittings between horizontal runs of wireway and wall ducts to properly interface each raceway system.
- B. Where wall ducts are installed flush either vertically or horizontally as a collector duct, provide proper blocking and support in stud walls, adding a layer of studs as needed to prevent undercutting major structural elements of walls. Trim flange shall be set tight to wall surface with 1/16" tolerance each way.
- C. Wall ducts, if indicated to be surface mounted, shall be furnished with flangeless coverplates.
- D. All completed systems shall be provided with a factory prime painted finish, suitable for field finish painting.
- E. Wall ducts shall be equivalent to Square D Company "RWT" Series, as a standard of construction and quality.

2.5 SUPPORTS AND HANGERS

- A. Supports and hangers shall be installed in accord with all applicable codes and standards. They shall be corrosion - resistant, galvanized or furnished with an equivalent protective coating. All electrical raceways shall be hung independently from the building structure with UL listed and approved materials. Hangers and supports depending from the support systems of other trades work shall not be permitted, except with specific approval in writing from the Engineer. The use of tie wire for support or fastening of any raceway system is prohibited. Perforated metal tape shall not be used for raceway support.
- B. No raceway shall be installed on acoustic tile ceiling tees, or in any location that will impair the functioning, access or code-required clearances for any equipment or system.
- C. Supports for raceways shall be of materials compatible with the raceway, of malleable iron, spring steel, stamped steel or other approved material. Die-cast fittings are not permitted for supports.
- D. The installing contractor shall provide all necessary supports and braces for raceways, in a rigid and safe installation, complying with all applicable codes.
- E. Individual conduits routed on building walls, ceilings or equipment shall be secured by two- hole galvanized malleable iron or stamped steel pipe strap or "minerallac" 2-piece straps. The straps are to be anchored by an approved means such as expansion anchors, toggle bolts, through bolts, etc. Where required by codes or other standards, provide spacers behind mounting clamps to space conduits off walls.
- F. Supports may not be fastened to roof decking on drive pins.
- G. Individual conduits run on building steel shall be secured by means of clamp supports similar and equal to those manufactured by the C.C. Korn Company, Elcen Co., B-Line or approved equivalent. Provide korn clamps, bulb-tee, flange clamps, beam clamps, "minerallacs", etc.

- H. Where feasible, vertical and/or horizontal runs of conduit shall be grouped in common hangers on "trapezes" of channel stock as manufactured by "Unistrut" or equivalent, 1-5/8" minimum depth. Utilize conduit clamps appropriate to the channel.
- I. Channel strut systems for supporting electrical equipment or raceways shall be constructed of 16 gauge minimum hot dip galvanized steel with 9/16" diameter holes on 8" centers, with finish coat of paint as manufactured by Unistrut, B-Line, Kindorf, or approved equivalent.
- J. The minimum diameter of round all-thread steel rods used for hangers and supports shall be 1/4", 20 threads per inch. All-thread rod shall be furnished with a corrosion-resistant finish.
- K. Welding directly on conduit or fittings is not permitted.
- L. Provide riser support clamps for vertical conduit runs. Riser support clamps shall be of heavy gauge steel construction. Install riser support clamps at each floor level penetration, or as otherwise required.
- M. Provide conduit cable support clamps for vertical conductor runs as required or indicated on plans. Clamps to be insulating wedging plug, with malleable iron support ring. Install within properly sized and anchored junction box.
- N. Spring steel clips and fittings such as those manufactured by HITT-Thomas, Caddy-Erico, or approved equivalent, with black oxide finish are permitted in any indoor dry location for concealed work, where acceptable to the local authority having jurisdiction.
- O. Raceways shall be securely and rigidly fastened in place at intervals specified here-in-before with wall brackets, conduit clamps, approved conduit hangers, or beam clamps. Fastenings shall be made by wood screws or screw type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat treated or spring steel tension clamps on steel work. Bolts, screws, etc. used in securing the work shall be galvanized and of ample size for the service. Assembly bolts, nuts, washers, etc., shall be zinc or cadmium coated. Raceways shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joists shall avoid cutting the main reinforcing bars.
- P. The use of perforated iron straps or wire for supporting conduits will not be permitted.
- Q. Where conduits are installed in groups on a common steel channel type support, each conduit shall be secured by Korns, Unistrut, Kindorf clamps or equal.
- R. Rigid conduits, where they enter panelboards, cabinets or pull boxes shall be secured in place by galvanized, double locknuts (one inside and one outside) and non-metallic bushings. All bushings shall have insulating material which has been permanently fastened to the fittings. Bushings for conduit 1-1/2 inches trade size and larger, which are used for power distribution, shall be complete with grounding lug and shall be bonded to the box by means of bare copper wire.

2.6 FIRESTOPPING MATERIALS

- A. All conduits and cables penetrating fire or smoke rated floors, walls and ceilings shall be firestopped. Firestopping assembly must be UL listed. All corridor walls, storage room walls and mechanical room walls are to be considered minimum one-hour fire rated. Elevated slabs and floors shall also be considered minimum one-hour rated. Refer to Architectural drawings for additional rating requirements.
- B. Provide shop drawings indicating penetration detail for each type of wall and floor construction. Shop drawings must be specific for each individual type. (i.e., one-hour fire rated gypsum wall board with insulated metal pipe penetration.)
- C. 3M fire protection products are listed below. Equivalent products may be submitted if they are UL listed.
- D. The manufacturer of the firestopping materials must provide on site training for the contractor. The training session shall demonstrate to the contractors the proper installation techniques for all the

firestopping materials. The training session shall be four hours minimum. Contact the Engineer prior to conducting this training session.

- E. Firestopping materials to include but not limited to the following:
1. 3M fire barrier FS-195 wrap/strip.
 2. 3M fire barrier CP 25 caulk.
 3. 3M fire barrier MP moldable putty.
 4. 3M fire barrier RC-1 restricting collar with steel hose clamp.
 5. 3M fire barrier damming materials.
 6. 3M fire barrier CS-195 composite sheet.
 7. 3M fire barrier fire dam 150 caulk.
 8. Steel sleeves.

2.7 SPECIALTIES

- A. All EMT terminations at junction boxes, panels, etc. shall be made with case hardened locknuts and appropriate fittings, with insulated throat liners. Insulating terminations shall be manufactured as a single unit. The use of split sleeve insulators is not permitted.
- B. All rigid conduit, except main and branch feeders, shall have heavy fiber insulating bushings reinforced with double locknuts. All branch and main feeders shall have insulated bushings with grounding lugs and shall be bonded to enclosures with appropriately sized copper jumpers, except at pad mounted transformers. Bonding jumpers shall be installed as required by the NEC and other applicable codes.
- C. All conduit stubbed through floor during construction shall have openings protected with plastic caps approved for this purpose. Connections on both ends of all flexible conduit shall be equivalent to Thomas and Betts, Ideal, Appleton, Efcor, or approved equivalent, rated for the environment.
- D. Nylon pull strings shall be provided in all empty conduit and in all conduit installed for other trades. Pull strings shall be left securely tied off at each end.
- E. Where spare raceways terminate in switchboards or motor control centers a fishtape barrier shall be provided.
- F. All outlet, junction and pull boxes shall be grounded with pigtail to the equipment grounding conductor.
- G. All fire alarm raceways in concealed areas, data/mechanical/electrical rooms and above ceilings shall be red. Exposed fire alarm raceways shall match adjacent finishes.
- H. All junction, outlet and pull boxes in data/mechanical/electrical rooms and above ceilings shall be identified with panel and circuit designation on outside of covers. All junction, outlet and pull boxes in exposed areas shall be identified with panel and circuit designation on inside of covers.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC
 2. Concealed Conduit, Aboveground: GRC
 3. Underslab Conduit: Concrete encased GRC.
 4. Underslab Medium-Voltage Conduit: Concrete encased GRC.
 5. Refer to Section 260543, "Underground Ducts And Raceways For Electrical Systems" for additional requirements.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Concealed in Ceilings and Interior Walls and Partitions: EMT, IMC or GRC

2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 3. Damp or Wet Locations: GRC
 4. Exposed, Not Subject to Physical Damage: GRC, IMC or EMT. Raceway locations include the following:
 - a. Electrical Rooms
 5. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms (below 8'-0").
 - d. Gymnasiums.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only where indicated on Drawings.
- G. PVC conduit and plastic molding are not acceptable except in caustic environments.
- H. Aluminum is not acceptable in caustic environments.
- 3.2 INSTALLATION
- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 - B. This Contractor shall lay-out and install all conduit systems so as to avoid any other service or systems, the proximity of which may prove injurious to the conduit, or conductors which it confines. All conduit systems, except those otherwise specifically shown to the contrary, shall be concealed in the building construction or run above ceilings. Size of all conduit shall conform to Annex C, of the National Electrical Code, unless otherwise shown on the Contract Drawings.
 - C. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - D. Support conduit within 12 inches of enclosures to which attached.
 - E. No conduit shall be installed in or below poured concrete slabs except with permission of the architect or engineer. Conduit shall be held at least 12" from flues, steam or hot water pipes.
 - F. Intermediate grade conduit will not be acceptable in place of galvanized rigid steel conduit.
 - G. All exposed conduit shall be installed with runs parallel or perpendicular to walls, structural members or intersections of vertical planes and ceilings, with right angle turns consisting of cast metal fittings or

symmetrical bends unless otherwise shown. All conduit shall have supports spaced not more than eight feet apart. Randomly routed conduits will not be acceptable.

- H. Conduit shall be installed in such a manner so as to insure against collection of trapped condensation. All runs of conduit shall be arranged so as to be devoid of traps. Trapped conduit runs shall be provided with explosion proof drains at low points. Runs of conduit between junctions shall not have more than the equivalent of three 90° bends.
- I. Junction boxes shall be installed so that conduit runs will not exceed 50', or as shown on the Contract Drawings. Junction boxes shall be sized per NEC, Article 370.
- J. Install electrical raceways in accordance with manufacturer's written instructions, applicable requirements of latest edition of the NEC, and NECA "Standard of Installation", complying with recognized industry practices.
- K. Coordinate with other trades, including metal and concrete deck trades, as necessary to interface installation of electrical raceways and components.
- L. Level and square raceway runs, and install at proper elevations and required heights. Hold tight to structure wherever possible, to maximize available space and not restrict other trades.
- M. Complete installation of electrical raceways before starting installation of cables or wires within raceways.
- N. Bushings shall be provided on conduits to protect cables transitioning from conduits to cable tray pathway.
- O. Provide plastic bushings on the end of all conduit stub-ups.
- P. Install electrical raceways in accordance with manufacturer's written instructions, applicable requirements of latest edition of the NEC, and NECA "Standard of Installation", complying with recognized industry practices.
- Q. Coordinate with other trades, including metal and concrete deck trades, as necessary to interface installation of electrical raceways and components.
- R. Level and square raceway runs, and install at proper elevations and required heights. Hold tight to structure wherever possible, to maximize available space and not restrict other trades.
- S. Raceways installed in exterior locations shall receive one coat of primer, two coats finish paint after preparation of galvanizing, color selected by Architect. Exposed raceways in painted interior areas shall be similarly painted.
- T. Conduits, cables, raceways, and enclosures under metal-corrugated sheet roof decking shall not be located within 1-1/2" of the roof decking, measured from the lowest surface of the roof decking to the top of the conduit, cable, raceway, or box. GRS is acceptable to route tight to bottom of roof deck.
- U. Conduits, cables, raceways, and enclosures are not permitted in concealed locations of metal-corrugated sheet decking type roofing.
- V. All conduit, tubing, raceways, ducts and duct banks shall be installed in such manner as to insure against collection of trapped condensation and raceway runs shall be arranged so as to be devoid of traps.
- W. Where conduits pass through exterior concrete walls of facilities, the entrance shall be made watertight. This shall be done by providing pipe sleeves in the concrete with 1/2" minimum entrance seal.
- X. All necessary precautions to prevent the lodgment of dirt, plaster, or trash in all conduit or tubing, fittings and boxes during construction shall be taken. All conduit in floors, concrete or below grade shall be swabbed free of debris or moisture before wires are pulled.

- Y. Liquid-tight flexible steel conduit shall be used for connections to all vibrating equipment, including motors and transformers, with a minimum of 18-inches of flex looped to avoid restraining equipment vibrating.
- Z. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- AA. Grounding bushings and bonding jumpers shall be used on conduit terminations at all junction boxes, pull boxes and cabinets to maintain grounding integrity of conduit system.
- BB. Do not install conduits or raceways on exterior facades or within wall cavities.
- CC. All conduit and PVC conduits installed below grade or below slabs (where indicated) shall be concrete encased.
- DD. Do not drill into bar joists to support raceways or cables.
- EE. All utilities and underground conduits shall be surveyed and recorded on as-built drawings.
- FF. All exterior conduits and raceways shall be painted.
- GG. All floor slabs and concrete walls shall be x-rayed before cutting.
- HH. Contractor must maintain a minimum 12" clear space above, 6" below and a minimum 26" clear on one side of all cable trays and wireways (both new and existing).
- II. Absolutely no "LB's" are allowed in any communications conduit installation.
- JJ. Conduit ends at a wireway will be mechanically fastened, have plastic bushings, and be wire bonded to the wireway.
- KK. Underground electric, cable TV, telephone service or other rigid steel conduit and underfloor rigid steel conduit below the concrete floor slab shall be painted with two coats of bitumastic paint, such as "Asphaltum".
- LL. All underground or underfloor conduits shall be swabbed free of all moisture and debris before conductors are pulled.
- MM. At least two (2) 1" and three (3) 3/4" conduits shall be stubbed from all flush-mounted panelboards into the nearest accessible area for future use. Provide suitable closures for these stubs. Identify each stub with a suitable hang tag.
- NN. Coordinate with other trades, including metal and concrete deck trades, as necessary to interface installation of electrical raceways and components.
- OO. All underground conduits shall be buried to minimum depth of 24" from the top of the concrete encasement or raceway to finished grade, unless otherwise noted on plans. Observe minimum burial requirements of local utility company where their standards or regulations apply. Conduits containing primary power conductors, (higher than 600 volts to ground) shall be 48" to top below finished grade, unless otherwise noted on plans. Conduits containing secondary power conductors, (600 volts and less to ground) shall be 36" to top below finished grade, unless otherwise noted on plans.
- PP. Provide uni-strut racks where multiple conduits are supported at one location.
- QQ. Provide separate a completely separate raceway system of conduits, pull-boxes, etc. for each emergency power branch and for normal power for complete separation per NEC.
- RR. Where existing panels are flush-mounted in walls, contractor shall cut, patch, and repair existing construction as required for concealed conduit entry for new connections to those panels.

SS. Expansion-Joint Fittings:

1. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
2. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

TT. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.4 SPECIALTIES

- A. All EMT terminations at junction boxes, panels, etc. shall be made with case hardened locknuts and appropriate fittings, with insulated throat liners. Insulating terminations shall be manufactured as a single unit. The use of split sleeve insulators is not permitted.
- B. All rigid conduit, except main and branch feeders, shall have heavy fiber insulating bushings reinforced with double locknuts. All branch and main feeders shall have insulated bushings with grounding lugs and shall be bonded to enclosures with appropriately sized copper jumpers, except at pad mounted transformers. Bonding jumpers shall be installed as required by the NEC and other applicable codes.
- C. All conduit stubbed through floor during construction shall have openings protected with plastic caps approved for this purpose. Connections on both ends of all flexible conduit shall be equivalent to Thomas and Betts, Ideal, Appleton, Efcor, or approved equivalent, rated for the environment.
- D. Pulling lines shall be left in all open conduit systems and shall be non-metallic, left securely tied off at each end cap any unused conduits.
- E. Where spare raceways terminate in switchboards or motor control centers a fishtape barrier shall be provided.
- F. All metal boxes, junction boxes and pull boxes shall be grounded with pigtails to the equipment grounding conductor.
- G. All empty raceways inside switchgear and open spaces shall be capped.
- H. All fire alarm raceways shall be red. Painted red conduit will not be accepted. Junction and pull boxes shall be identified with panel and circuit number on covers.
- I. All emergency power raceways shall be blue. Painted conduit will not be accepted. Junction and pull boxes shall be identified with panel and circuit number on covers.
- J. All conduits in theaters shall be black. Painted conduit will not be accepted. Junction and pull boxes shall be black and identified with panel and circuit number on inside of covers.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260535 - CABINETS, OUTLET BOXES AND PULL BOXES FOR ELECTRICAL SYSTEMSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section Includes: Boxes, enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 CABINETS, OUTLETS AND PULL BOXES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Adalet.
 - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman; a Pentair company.
 - 7. Hubbell Incorporated; Killark Division.
 - 8. Kraloy.
 - 9. Milbank Manufacturing Co.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney; a brand of EGS Electrical Group.
 - 12. RACO; a Hubbell Company.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.
- B. Cabinets for lighting and power, telephone, pull boxes, outlet boxes, or any other purposes specified or shown on the Contract Drawings, shall be constructed of code gauge, galvanized steel with sides formed and corner seams riveted or welded before galvanizing. Boxes assembled with sheet metal screws will not be accepted. Pull boxes shall include all boxes used to reduce the run of conduit to the required number of feet or bends, supports, taps, troughs, and similar applications and shall also be constructed as specified above.
- C. All cabinets and boxes for NEMA 1 and 1A application shall be provided with knockouts, as necessary, or shall be cut in the field by approved cutting tools which will provide a clean, symmetrically cut

opening. All boxes, except panelboards, shall be provided with code gauge fronts with hex head or pan head screw fasteners. Fronts for panelboards shall be as specified for panelboards.

- D. Ceiling outlet boxes shall be galvanized steel, 4" octagonal, not less than 2 1/8" deep, with lugs or ears to secure covers, and those for use with ceiling lighting fixtures shall be fitted with 3/8" fixture studs fastened to the back of the boxes, where applicable. Provide adequate support with at least a 2 x safety factor for the anticipated fixture weight.
- E. Special size concealed outlet boxes for clocks, speakers, alarms, TV, etc., shall be provided by the manufacturer of the equipment.
- F. The location of outlets, as shown on the drawings, shall be considered as approximate only. It shall be incumbent upon this Contractor to study the general building drawings, with relation to spaces surrounding each outlet, in order to make his work fit the work of others and in order that when the devices or fixtures are installed, they will be symmetrically located and will not interfere with any other work or equipment. Any change in fixture or layout shall be coordinated with and approved by the Engineer before this change is made. Regardless of the orientation shown on the drawings, all devices shall be easily accessible when installed.
- G. All outlets, pull boxes, junction boxes, cabinets, etc., shall be sized per the current edition of the National Electrical Code.
- H. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- I. Outlet boxes and junction or pull boxes shall be threaded for rigid-threaded conduit, dust-tight vapor-tight or weatherproof as required for areas other than for NEMA 1 or 1A application. These shall be as manufactured by Crouse-Hinds, Appleton, Killark, or approved as equivalent.
- J. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- K. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.
- L. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- M. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- N. NEMA 1 or 1A outlet boxes or pull or junction boxes shall be as manufactured by Appleton, Steel City, T & B, or approved equivalent.
 - 1. Outlet boxes for switches, receptacles, etc., concealed in walls shall be galvanized steel, 4" x 4" x 2 1/8" deep with plaster cover for the number of devices as required and to be flush with finished wall. Where outlet boxes are installed in walls of glazed tile, brick, concrete block, or other masonry which will not be covered with plaster or in walls covered by wood wainscot or paneling, deep sectional masonry boxes shall be used and they shall be completely covered with the plates or lighting fixtures. This Contractor shall cooperate with the brick layers, block layers and carpenters to insure that the outlet boxes are installed straight and snugly in the walls. Receptacles shall be set vertically in walls.
 - 2. Outlet boxes for data/voice locations shall be as specified in Division 27.
- O. Unless otherwise noted on the drawings or in the specifications, outlet boxes shall be installed at the following heights to centerline of box:

Wall Switches, Control Stations.....3'-10"

| | |
|--|--|
| Convenience Outlets..... | 1'-6" |
| Above Counter, Convenience Outlets..... | Bottom at 2" above top of backsplash |
| TV Outlets | 1'-6" |
| TV Outlets - At Wall Brackets | 7'-2" |
| Desk Telephones | 1'-6" |
| Wall-Mounted Telephone..... | 3'-10" |
| Weatherproof Outlets | 2'-2" |
| Disconnects, Branch Panelboards | 5'-0" max. to centerline and no more than 6'-6" to top |
| Fire Alarm Manual Stations | 3'-10" |
| Fire Alarm Audio and/or Visual Unit..... | 80" AFF to bottom of device or 6" below ceiling, whichever is lower |

Note: Contractor is to refer to Architectural elevations and coordinate device mounting heights, quantities, and locations.

- P. Outlet boxes mounted in glazed tile, brick, concrete block or other types of masonry walls shall be mounted above or below the mortar joint. Do Not Split The Mortar Joint.
- Q. Boxes for more than two (2) devices shall be for number of devices required and shall be one piece. No ganging of single switch boxes will be allowed.
- R. Outlets provided shall have only the holes necessary to accommodate the conduit at the point of insulation and shall be rigidly secure in position. Boxes with knockout removed and openings not used shall be replaced or provided with a listed knockout closure.
- S. Exterior outlets shall be die-cast aluminum, weather-proof with gasketed covers and baked on grey enamel finish, per ANSI 61.
- T. Boxes up to 4-11/16 square size shall be fastened to their mounting surface with two fasteners of proper size. Larger sizes shall be fastened with four fasteners, minimum.
- U. Openings for conduit entrance in cabinets and boxes shall be prefabricated, punched, drilled and/or reamed. The use of a cutting torch for this purpose is prohibited.
- V. Aluminum is not acceptable in caustic environments.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Install electrical boxes as required for splices, taps, wire pulling, equipment connections.
- D. Do not install flush mounting boxes back-to-back in walls; install with minimum 6-inches separation. Install with 24-inches separation in acoustic rated walls.
- E. Do not fasten boxes to ceiling support wires or other piping systems.
- F. Support all boxes independently of conduit.
- G. Grounding bushings and bonding jumpers shall be used on conduit terminations at all junction boxes, pull boxes and cabinets to maintain grounding integrity of conduit system.

3.2 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section Includes:
 - 1. Direct-buried conduit, ducts, and duct accessories.
 - 2. Concrete-encased conduit, ducts, and duct accessories.
 - 3. Handholes and boxes.
 - 4. Manholes.

1.3 DEFINITIONS

- A. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include duct-bank materials, including separators and miscellaneous components.
 - 2. Include ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Include accessories for manholes, handholes, boxes and other utility structures.
 - 4. Include warning tape.
- B. Shop Drawings:
 - 1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include structural fabrication drawings stamped by a Structural Engineer registered in the State of Indiana. Drawings shall detail concrete and reinforcement requirements.
 - b. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - c. Include duct entry provisions, including locations and duct sizes.
 - d. Include reinforcement details.
 - e. Include frame and cover design and manhole frame support rings.
 - f. Include Ladder details.
 - g. Include grounding details.
 - h. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - i. Include joint details.
 - 2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
 - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
 - b. Include duct entry provisions, including locations and duct sizes.

- c. Include cover design.

1.5 INFORMATIONAL SUBMITTALS

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer.
- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 MAINTENANCE MATERIALS SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE/WARRANTY

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. The manhole shall be provided with a manufacturer's warranty against leaks in the manhole resulting from cracks in the manhole structure. The length of this warranty shall be for five years from date of installation.

1.8 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two weeks in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.

2.2 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. Rigid Nonmetallic Conduit (RNC): NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.
- B. Duct Accessories:
 - 1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
 - 2. Warning Tape: Metallic Underground-line warning tape per published Owner's standards.

2.4 HANDHOLES AND BOXES

- A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Tier 15.
 - 1. Color: Gray.
 - 2. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, as indicated for each service.
- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The layout of duct banks shall be generally parallel and perpendicular to property and building lines.
- B. All conduit and ducts must be terminated with bell ends at the manhole, facility or other termination point. A nylon pull string will be installed and tied off in each conduit.
- C. All underground conduits and ducts, rigid or PVC, installed shall be added in-multiples of two.
- D. All underground conduits, duct banks and raceways shall be encased in steel reinforced, concrete (3500 psi minimum).
- E. Additional reinforcement shall be used when crossing roadways.
- F. All communications ducts shall be a minimum of twelve (12) inches from power duct banks or cables. All communications ducts shall also be a minimum of twenty four (24) inches from steam pipes and condensate lines if crossing perpendicular. When communication ducts run parallel to steam lines a minimum of a six (6) foot separation is required to avoid conduction of heat. All other duct separations must comply with the National Electric Code.
- G. Rigid steel conduit, encased in reinforced concrete, shall be used in any location subject to unbalanced pressure, such as under slabs, roadways, driveways, or foundations.
- H. All necessary precautions shall be taken by the contractor during construction to prevent the lodging of dirt, plaster or trash in all conduit, tubing, fittings and boxes. All conduits in floors, concrete or below grade shall be swabbed free of debris and moisture before wires are pulled.

3.2 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

3.3 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables More than 600 V: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40 PVC, concrete-encased unless otherwise indicated.
- D. Underground Ducts 600V and less Crossing Driveways and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.
- E. Ducts for Electrical Cables More than 600 V below building slab: Rigid Steel Conduit, encased in red reinforced concrete.
- F. Ducts for Electrical Feeders 600 V and Less below building slab: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete or Rigid Steel Conduit.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply Division 32.
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" requirements in Division 01.

3.5 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches vertically and 25 feet, horizontally, at other locations unless otherwise indicated.
- D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- E. Installation Adjacent to High-Temperature Steam Lines: Where duct banks are installed parallel to underground steam lines, perform calculations showing the duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

- F. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct banks with calculated expansion of more than 3/4 inch (19 mm).
 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- H. Pulling Cord: Install 100-lbf test nylon cord in empty ducts.
- I. Concrete-Encased Ducts: Support ducts on duct separators.
1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 for pipes less than 6 inches in nominal diameter.
 2. Width: Excavate trench 3 inches wider than duct bank on each side.
 3. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
 4. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 5. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
 7. Use manufactured duct long sweep fittings for stub-ups at poles and equipment, at building entrances through floor. All changes of direction in duct run shall use factory or field fabricated swaps with 10' minimum radius unless otherwise indicated. Extend concrete encasement throughout length of elbow.
 8. Reinforcement: Reinforce concrete-encased duct banks for their entire length. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
 10. Concrete Cover: Install a minimum of 2 inches of concrete cover at top and sides, and a minimum of 6 inches on bottom of duct bank.
 11. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (15-mm) reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.

12. Pouring Concrete: Concrete shall be dyed red for power and yellow for communications. Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

J. Direct-Buried Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Division 31 for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
2. Stagger spacers approximately 6 inches between tiers.
3. Depth: Install top of duct bank at least 36 inches below finished grade unless otherwise indicated.
4. Set elevation of bottom of duct bank below frost line.
5. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
6. Elbows: Install manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
8. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Division 31 for installation of backfill materials.
 - a. Place minimum 3 inches (75 mm) of sand as a bed for duct bank. Place sand to a minimum of 6 inches above top level of duct bank.
 - b. Place minimum 6 inches of engineered fill above concrete encasement of duct bank.
9. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 - C. Where indicated, cast handhole cover frame integrally with handhole structure.
 - D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
 - E. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
 - F. Hardware: Turn over removable hardware, including pulling eyes, cable stanchions, cable arms, to Construction Manager for use during next phase.
 - G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- 3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE
- A. Install hand-holes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.
 - B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
 - C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
 - D. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
 - E. Form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
 2. Dimensions as shown on drawings.
- 3.8 DUCT-BANK INSPECTION
- A. All communication duct runs shall be inspected and approved by Owner Engineering staff prior to pouring of concrete. At least twenty four (24) hour prior notice will be given to Owner that a pour will be taking place. Failure to obtain inspection and approval in writing will result in removal of ductbank.
 - B. All primary power duct runs shall be inspected and approved by Owner Engineering staff prior to pouring of concrete. At least twenty four (24) hour prior notice will be given to Owner that a pour will be taking place. Failure to obtain inspection and approval in writing will result in removal of ductbank.
- 3.9 DRAINAGE OF DUCT-BANKS
- A. Duct-banks shall be pitched to drain toward manholes. All conduit, tubing, raceways, ducts and duct banks shall be installed in such manner to insure against collection of trapped condensation. Raceway runs shall be arranged to be void of traps.
 - B. When conduits pass through exterior concrete walls of any facility, the entrance shall be watertight. Wall sleeves at entrance points must be sized to provide a minimum of 1/2-inch clearance around the conduit to allow for proper sealing of the penetration.

- C. All conduits shall have watertight connections and be sloped so they drain away from the building entrance. All empty conduits are to be sealed with the proper materials to prevent water drainage into the building.

3.10 MARKINGS

- A. Utility markers shall identify ALL conduit and duct-bank routes. The type of marker and manufacturer shall be obtained from Owner Project Management. Utility markers shall conform to Owner Project Management's Legend for Utility Markers. Prior approval and coordination with Owner Manager of Utilities, and other concerned parties is necessary when the situation requires any modification to the conduit system.
- B. Damages incurred to any conduit are the responsibility of the party involved. All damages shall be reported to Owner Manager of Utilities immediately.

3.11 GROUNDING

- A. Ground underground ducts and utility structures with minimum of two (2) 3/4" x 10' ground rods.

3.12 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- (150-mm-) long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 3. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.13 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260553 - IDENTIFICATIONS FOR ELECTRICAL SYSTEMSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 DEFINITIONS AND ABBREVIATIONS

- A. T - Transformer
- B. SWGR – Switchgear.
- C. SWBD – Switchboard.
- D. ATS - Automatic Transfer Switch.
- E. MCC - Motor Control Center.
- F. DP - Distribution Panel. Electrical distribution panel which is an integral part of a switchboard or switchgear but has its own isolation circuit breaker.
- G. P – Panel. Electrical distribution panels with manually operated circuit breakers which feed other distribution panels or directly to loads. These are generally the last distribution panel before the load.
- H. N - Normal power system. Annotates that the associated component is part of the Normal Power distribution system and receives no backup power from the Emergency Power distribution system.
- I. E - Emergency power system. Annotates that the associated component is part of the Normal Power and Emergency Power distribution systems. In the event of a loss of the supply from the normal power system, the component will receive power from the emergency power system.
- J. BKR – Breaker. Switch which interrupts or establishes power flow to its associated load.
- K. DISC - Disconnect Switch. Manually operated knife switch which interrupts or establishes power flow to its associated load.

1.4 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 FLOOR MARKING TAPE

- A. 2-inch wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.2 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES"
- F. Provide warning signs for the enclosures of electrical equipment including pad-mounted transformers, pad-mounted switches, and switchgear having a nominal rating exceeding 600 volts.

1. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.
2. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field. Sign shall be Panduit No. PASO710D72 or approved equal.

2.3 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.4 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).
- C. Retain paragraph below to specify type of label for identifying outdoor equipment if specified in "Identification Schedule" Article.
- D. Stenciled Legend: In non-fading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.5 CABLE TIES

- A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Clear
- B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
 1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 5. Color: Clear

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Cable Ties: For attaching tags.
 - 1. Indoors: Plenum rated.
 - 2. Outdoors: UV-stabilized nylon.
- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.
- H. Equipment, disconnect switches, switchgear, switchboards, panelboards, transformers, motor starters, variable frequency drives, special device plates, and similar materials shall be clearly marked as to their function and use. Markings shall be applied neatly and conspicuously to the front of each item of equipment with 1/2" black lamacoid plate (or equivalent) with white letters 1/4" high unless otherwise specified.
- I. PANELBOARD DIRECTORIES
 - 1. The Contractor shall provide clearly legible typewritten directories in each electrical panel indicating the area, item of equipment, etc. controlled by each switch, breaker, fuse, etc. These directories are to be inserted into plastic cardholders on back door in each panel. Descriptions shall be approved by the Owner.
 - a. EXAMPLES:
LIGHTS, ROOM 100
RECEPTION, ROOM 200
 - 2. Any existing panels which are affected by this contractor's work shall also be provided with new typewritten directories.
 - 3. Provide electronic Excel files of all directories to owner as part of Close-out Documentation.
 - 4. Panel Schedules and circuit numbers on Record Drawings shall match.
- J. All electrical distribution equipment shall be provided with a black lamacoid plastic plate with 1/2" white letters for panel designation and 1/4" white letters showing voltage and feeder information. This includes branch circuit panelboards, switchboards, switchgear, disconnect switches, transformers, motor starters, variable frequency drives and lighting control panels, Branch circuit switches shall be designated as to function. Electrical distribution equipment labels shall indicate the source they are fed from, and the circuit number at that source. Clearly indicate the exact label legend to be furnished with each panelboard

and switchgear on the shop drawings for each item of equipment prior to submission of shop drawings. Refer to drawings for further details.

- K. Where electrical distribution equipment, including branch circuit panelboards, switchboards and switchgear, are connected to an emergency source, the lamacoid plate shall be red, and the word "EMERGENCY" shall be incorporated into the legend. Also, provide similar plates and legends for automatic transfer switches, as appropriate. Refer to drawings for further details.
- L. Lamacoid plates shall be located at center of top of trim for branch circuit panels, switch gear, and centered at side for branch circuit switches. Fasten with self-tapping stainless steel screws or other approved method.
- M. All junction boxes utilized for life-safety branch emergency power circuits, connections, devices, etc. shall have the cover painted blue. Mark over paint with panel and circuit number.
- N. All concealed junction boxes utilized for fire alarm circuits, connections, devices, etc. shall have the cover painted red. Mark over paint with stenciled letters "FA".
- O. All new receptacle cover plates shall be marked with their panel and circuit number(s) with clear, machine printed adhesive labels with black lettering. Circuit number shall also be hand written inside outlet box with black permanent marker.
- P. All systems requiring room names and/or numbers for labeling or programming shall use the Owner's actual room name and numbering scheme, not floor plans. All reprogramming shall be included as required to accommodate construction phasing.
- Q. All junction, outlet and pull boxes in data/mechanical/electrical rooms and above ceilings shall be identified with panel and circuit designation on outside of covers. All junction, outlet and pull boxes in exposed areas shall be identified with panel and circuit designation on inside of covers.
- R. The inside of all junction and backboxes shall be marked with panel and circuit number in permanent marker.
- S. All identifications shall be consistent with the owner's standard practices, especially within existing facilities. Where the requirements here-in are in conflict with such standard practices, the contractor shall notify the engineer in writing prior to ordering any material for clarification.
- T. Identification shall consist of all UPPER CASE LETTERS.
- U. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- V. Apply identification devices to surfaces that require finish after completing finish work.
- W. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification devices.
- X. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- Y. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- Z. Fire alarm system: Install a nameplate on the fire alarm panel to indicate the panelboard and circuit number supplying the fire alarm system.
- AA. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- BB. Accessible Raceways, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.
- CC. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
1. Emergency Power.
 2. Power.
 3. UPS.
- DD. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- EE. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- FF. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- GG. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- HH. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- II. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer and load shedding.
- JJ. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
- KK. Labeling Instructions:
1. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
 2. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

3. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
4. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 260573 - ELECTRICAL STUDIESPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Provide a short-circuit, component protection, arc-flash hazard analysis, and protective device coordination study for the electrical distribution system beginning with all power sources and ending with the lowest level power, lighting and receptacle panels, and motor control equipment.
- B. This Section includes computer-based, fault-current, arc-flash and overcurrent protective device coordination studies. Hand calculations are not acceptable. Protective devices shall be set based on results of the protective device coordination study.
- C. Electrical Studies shall be performed by the Low-Voltage Switchboard manufacturer. All Electrical Studies required by this specification shall be completed within five (5) weeks from award of project. The Electrical Contractor shall provide all required data to Low-Voltage Switchboard manufacturer within one (1) week and the manufacturer will have four (4) weeks to complete the studies.
- D. A licensed professional engineer employee of the Low-Voltage Switchboard manufacturer shall provide electrical power system studies for the project using the latest version of one of the approved software packages. The software model files shall be submitted with the report. The analysis shall follow the latest IEEE 1584 guidelines. An example report will be provided by the Owner upon request.
- E. Studies specified herein must be submitted and approved prior to release of any affected equipment. Revisions to equipment or devices necessary to meet study recommendations shall be at the Manufacturer's expense.
- F. All adjustments and settings recommended by these studies shall be made prior to any testing.
- G. The analysis shall be submitted to the engineer of record prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing.

1.3 PURPOSE

- A. The study shall calculate the worst case available short circuit current at each point in the electrical distribution system considering all power sources under all permissible system operating and switching modes. The study shall be performed in accordance with Part 3 of this specification. The overcurrent protective devices shall have an interrupting and/or withstand rating equal to or greater than the available short circuit current at the applicable time band (1/2, 5, or 8 cycle) at the point of application. Discrepancies shall be noted and called to the attention of the Architect/Engineer.
- B. The overcurrent protective devices shall be analyzed for adequate short circuit rating. This analysis shall identify any potential insufficient equipment ratings of existing equipment based on actual available utility values.

- C. The study shall also include an arc flash hazard analysis for all electrical equipment. The analysis shall determine the flash protection boundary, incident energy, and required level of Personal Protective Equipment (PPE) for workers at the electrical equipment. The arc flash protection boundary and incident energy shall be determined based upon a working distance as defined in per IEEE 1584, based on system voltages. The electrical distribution equipment shall be field marked with this information in accordance with NFPA 70E.
- D. The above study shall use equipment designation (labeling) that is consistent with the electrical system diagrams. Equipment shall be readily identifiable without the use of a cross reference list.

1.4 SUBMITTALS

- A. Product Data: Computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals:
 - 1. The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - a. Coordination-study input data, including completed computer program input data sheets.
 - b. Study and Equipment Evaluation Reports.
 - c. Coordination-Study Report.
 - d. Short Circuit Study and Coordination Study including all input data.
 - e. Study recommendations for device settings, fuse types/ sizes and Equipment Evaluation findings.
 - f. Report shall include any identified recommendations for improvements or suggestions for correction of deficiencies for consideration by the Architect/Engineer.
 - g. Arc-Flash Hazard Calculations and list of data for Labels, including any recommendations to reduce any PPE Category 4 or higher hazard level to a PPE Category 3 or lower hazard level.
 - 2. The results of the study shall be summarized in report form, for review and approval by the Architect/Engineer.
 - 3. The results of all studies shall include the following:
 - a. Descriptions, purpose, basis, and scope of study.
 - b. Fault current calculations including definition of terms and guide for interpretation of computer printout.
 - c. Tabulations of protective device and equipment ratings versus maximum calculated short circuit duties, and commentary regarding same.
 - d. Flash hazard analysis report for newly installed and directly impacted existing electrical equipment. Based on the worst case resulting in Greatest Personnel Hazard.
 - e. Time versus current curves with tabulations of overcurrent protective device settings and selective coordination analysis and commentary regarding same.
 - f. The above studies shall be submitted to the Architect/Engineer for review and comment, before any labels are printed.
 - g. If power company review and/or approval of device settings or fuse types/sizes is required, appropriate data shall be submitted to the power company for review and/or approval. The results of the power company review and /or approval shall be forwarded to the Architect/Engineer and included in the study report.
- E. The studies must bear the signature/seal of the Professional Electrical Engineer in the state where the project is located.

1.5 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 (power system analysis) for general study procedures.
- E. Comply with IEEE 1584 (guide for performing arc flash hazard calculations) for Arc Flash calculation procedures.

1.6 Commissioning

- A. This section specifies a system or a component of a system being commissioned as defined in Section 019113 Commissioning. Testing of these systems is required, in cooperation with the Owner and the Commissioning Authority. Refer to Section 019113 Commissioning for detailed commissioning requirements.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, provide products by SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Discrepancies shall be noted and called to the attention of Architect/Engineer.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags

that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Impedance of utility service entrance.
 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.
- B. Data shall be obtained for the power sources (campus 12 kV system and generators), impedance components (transformers, cables and busway), overcurrent protective devices (fuses, circuit breakers and relays) and other relevant equipment such as automatic transfer switches. Cable data (length, quantity per phase, size and type) shall be provided by the electrical contractor. Assumptions should only be used when the actual data is not available and the assumptions should be clearly listed in the report. Assumptions shall be kept to a minimum.
- C. A one line diagram shall be provided as part of the analysis and shall clearly identify individual equipment buses, bus numbers used in the analysis, cable information (length, quantity per phase, size and type), overcurrent device information (manufacturer, type and size), transformers, motors, transfer switches, generators, etc.
- D. The one line and analysis shall use a numbering scheme where each bus begins with a three digit number followed by a description (e.g., 102 MDP A or 103 ELEV DISC) and each connected circuit breaker or fuse shall have a corresponding designation (e.g., 102-1 MAIN CB, 102-2 ELEVATOR FDR or 103-1 ELEV DISC CB). An example one line will be provided by the Owner upon request.
- 3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
1. Switchgear and switchboard bus
 2. Medium-voltage switch and transformers
 3. Distribution panelboards
 4. Branch circuit panelboards
 5. Variable Frequency Drives
 6. Motor Control Centers
 7. Company switches
 8. Fused and non-fused disconnects
 9. Low-voltage transformers
 10. Individual circuit breakers
 11. Automatic transfer switches
 12. Generator
 13. Combination starter/disconnects
- B. Study electrical distribution system from normal and alternate emergency power sources throughout electrical distribution system for Project, using approved computer software program. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
1. Transformers:
 - a. ANSI C57.12.10
 - b. ANSI C57.12.22
 - c. ANSI C57.12.40
 - d. IEEE C57.12.00
 - e. IEEE C57.96
 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 3. Low-Voltage Fuses: IEEE C37.46.
 4. Circuit Breakers: IEEE c37.13.
- E. Study Report: Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
 3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- G. A table shall be included which lists the calculated short-circuit currents (rms symmetrical three phase), equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment at each bus.
- H. Any inadequacies shall be called to the attention of the engineer of record and recommendations made for improvements as soon as they are identified.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 - 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 - 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 - 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
 - 3. Device settings shall protect transformers according to IEEE C57.12.91, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 - 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.
- H. A table shall be included which lists the recommended settings of each circuit breaker and relay.

- I. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
- J. Deficiencies in protection and/or coordination shall be called to the attention of the engineer of record and recommendations made for improvements as soon as they are identified.
- K. The electrical engineer that performed the study shall be responsible to set the circuit breakers according to the analysis once the report has been approved by the engineer of record.

3.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- B. The analysis shall consider multiple possible utility scenarios as well as multiple system configurations where appropriate such as normal and emergency transfer switch positions and different main-tie-main configurations.
- C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system. This includes all switchboards, switchgear, motor-control centers, panelboards, busway and splitters.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not taken into consideration when determining the clearing time when performing incident energy calculations.
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment locations. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
 - K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
 - L. Incident energy and flash protection boundary calculations
 - 1. Arcing fault magnitude
 - 2. Protective device clearing time
 - 3. Duration of arc
 - 4. Arc flash boundary
 - 5. Working distance
 - 6. Incident energy
 - 7. Hazard Risk Category
 - 8. Recommendation for arc flash energy reduction
 - M. The Arc Flash Hazard Analysis shall include recommendations for reducing Arc Flash Incident Energy (AFIE) levels and enhancing worker safety.
 - N. Results of the Arc Flash Hazard Analysis shall be submitted in tabular form and shall include the following information for each bus location: bus name, protective device name, bus voltage, bolted fault, arcing fault, trip/delay time, equipment type, working distance, arc flash boundary, incident energy and protective clothing category.
- 3.6 ARC FLASH WARNING LABELS
- A. Arc flash labels shall be furnished and installed by the contractor of the Arc Flash Hazard Analysis.
 - B. The labels shall be 4 inches high by 6 inches wide and printed on a Brady THTL-25-483-1-WA label type or similar. The arc flash label shall be formatted similarly to the examples shown below (Figure 1) and include the wording indicated in the table (Table 1) for each PPE category.
 - C. After labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
 - D. The label shall include the following information, at a minimum:
 - 1. Arc Flash Incident Energy
 - 2. Location designation
 - 3. Nominal voltage
 - 4. Arc Flash protection boundary
 - 5. Hazard risk category
 - 6. Incident energy
 - 7. Working distance
 - 8. PPE category
 - 9. PPE clothing description
 - 10. PPE equipment description
 - 11. Voltage
 - 12. Glove class
 - 13. Shock protection boundaries according to NFPA 70E
 - 14. Analysis date
 - 15. Building name/number
 - 16. Equipment name and the upstream tripping device.

17. Engineering report number, revision number and issue date.
- E. Labels shall be machine printed, with no field markings.
- F. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings. Provide one arc flash label for all electrical equipment including, but not limited to, the following:
1. For each 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
 2. For each 480 and applicable 208 volt distribution panelboard, one arc flash label shall be provided.
 3. For each motor control center, one arc flash label shall be provided.
 4. For each low-voltage switchboard, one arc flash label shall be provided.
 5. For each switchgear, one flash label shall be provided.
 6. For medium voltage switches and transformers, one arc flash label shall be provided.
 7. For each fused or non-fused disconnect switch, one arc flash label shall be provided.
 8. For each generator and automatic transfer switches, one arc flash label shall be provided.
 9. For each variable frequency drives, one arc flash label shall be provided.
 10. For each combination starter/disconnects, one arc flash label shall be provided.
 11. For each fused or non-fused disconnect switch and individual circuit breakers, one arc flash label shall be provided.
 12. For each low-voltage transformer, one arc flash label shall be provided.
 13. For each company switch, one arc flash label shall be provided.

Figure 1. Example arc flash labels.

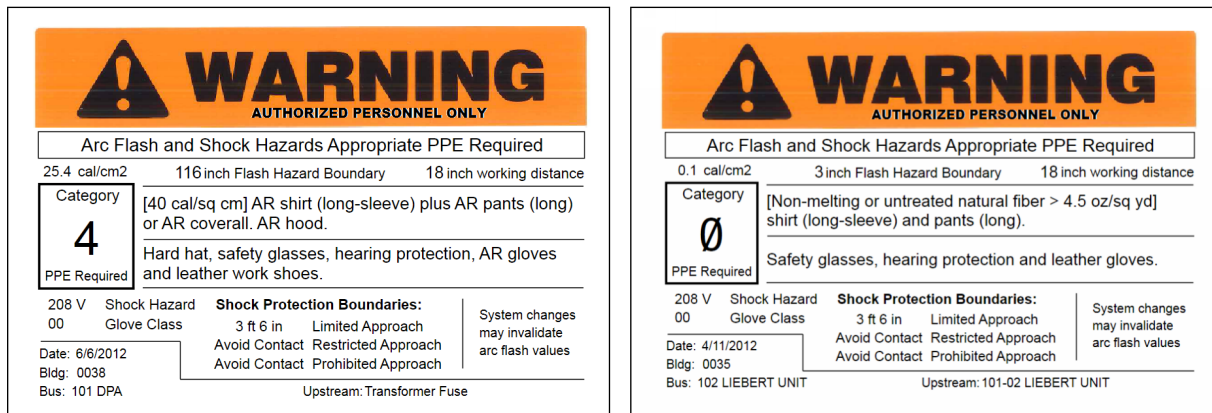


Table 1. Wording for the PPE related arc flash label fields.

| Incident Energy (calories/cm ²) | PPE Category | PPE clothing | PPE equipment |
|---|--------------|---|--|
| 0 - 1.2 | 0 | [Non-melting or untreated natural fiber > 4.5 oz/sq yd] shirt (long-sleeve) and pants (long). | Safety glasses, hearing protection and leather gloves. |
| greater than 1.2 - 4 | 1 | [4 cal/sq cm] AR shirt (long-sleeve) plus AR pants (long) or AR coverall. AR faceshield. | Hard hat, safety glasses, hearing protection, leather gloves and leather work shoes. |
| greater than 4 - 8 | 2 | [8 cal/sq cm] AR shirt (long-sleeve) plus AR pants (long) or AR coverall. AR balaclava and AR face shield or AR hood. | Hard hat, safety glasses, hearing protection, leather gloves and leather work shoes. |

| | | | |
|-------------------------|---|---|---|
| greater than 8 - 25 | 3 | [20 cal/sq cm] AR shirt (long-sleeve) plus AR pants (long) or AR coverall. AR hood. | Hard hat, safety glasses, hearing protection, AR gloves and leather work shoes. |
| greater than 25 - 40 | 4 | [40 cal/sq cm] AR shirt (long-sleeve) plus AR pants (long) or AR coverall. AR hood. | Hard hat, safety glasses, hearing protection, AR gloves and leather work shoes. |
| greater than 40 | X | Arc Flash Energy Exceeds the Rating of Category 4 PPE | Do not work on energized equipment |

3.7 INSTALLATION/START-UP

- A. The Electrical Contractor shall install equipment and protective devices in accordance with the approved short circuit and selective coordination study.
- B. The Electrical Contractor shall field mark equipment with flash hazard analysis data as required in accordance with codes and standards.
- C. The Manufacturer’s engineer shall set all adjustable overcurrent and/or timing devices in accordance with the approved study results, and then test the devices.
- D. The Manufacturer performing the study shall provide assistance to the installing Electrical Contractor during start-up of electrical system and equipment as needed.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 262200 – DRY-TYPE LOW-VOLTAGE TRANSFORMERSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. This Section includes the following types of dry-type distribution transformers and dry-type shielded isolation transformers rated 600 V and less, with capacities up to 1000 kVA.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code
- B. NEMA ST20
- C. Underwriters Laboratory (UL) and Canadian Standard Association
 - 1. UL 1561 – Dry-Type General Purpose and Power Transformers
 - 2. CSA C22.2 No.47-M90 Air-Cooled Transformer (Dry Type)
- D. UL 250 Enclosure for Electrical Equipment
- E. Transformers shall meet the minimum efficiency requirements per DOE 10 CFR Part 431 Energy Conservation program for Commercial Equipment, affective 2016.
- F. 2005 Energy Act PUBLIC LAW 109–58—AUG. 8, 2005 Comply with all Rules from Department of Energy
 - 1. 10 CFR 429
 - 2. 10 CFR 431

1.4 STANDARDS

- A. Transformers shall be listed by Underwriters Laboratories.
- B. Conform to the requirements of ANSI/NFPA 70.
- C. Transformers are to be manufactured and tested in accordance with NEMA ST20.
- D. Minimum Efficiencies per DOE 10 CFR 431.192 April 2013. Transformers shall comply with the requirements of being built after January 1, 2016. The efficiency of low-voltage dry-type distribution transformer shall be no less than that required for their kVA rating as listed below. Efficiency values are at 35% of nameplate rated load, determined according to the DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431. Low-voltage dry-type distribution transformers with kVA ratings not appearing below shall have their minimum efficiency level determined by linear interpolation of the kVA and efficiency values immediately above and below that kVA rating.

1. Single Phase Low-Voltage Dry-Type Distribution Transformers

- a. 15kVA 97.70% Efficient
- b. 25kVA 98.00% Efficient
- c. 37.5kVA 98.20% Efficient
- d. 50kVA 98.30% Efficient
- e. 75kVA 98.50% Efficient
- f. 100kVA 98.60% Efficient
- g. 167kVA 98.70% Efficient
- h. 250kVA 98.02% Efficient
- i. 333kVA 98.90% Efficient

2. Three Phase Low-Voltage Dry-Type Distribution Transformers

- a. 15kVA 97.89% Efficient
- b. 25kVA 98.23% Efficient
- c. 45kVA 98.40% Efficient
- d. 75kVA 98.60% Efficient
- e. 112.5kVA 98.74% Efficient
- f. 150kVA 98.83% Efficient
- g. 225kVA 98.94% Efficient
- h. 300kVA 99.02% Efficient
- i. 500kVA 99.14% Efficient
- j. 750kVA 99.23% Efficient
- k. 1000kVA 99.28% Efficient

1.5 ACTION SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated. Shall include the following:
 - 1. Confirmation that transformer(s) are UL 1561 Listed with a K-9 Rating.
 - 2. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight, inrush data RMS.
 - 3. Efficiency Data
 - 4. No load and full load losses will be calculated per NEMA ST20 test methods.
 - 5. Efficiency Curves
 - a. Linear Loads
 - b. Data per the non-linear load test program.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
 - 2. Wire Access Points
 - 3. Wire Bending Dimensions
 - 4. Location for Ground Lug Provisions

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Source quality-control test reports.
- C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.10 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

1.11 WARRANTY

- A. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. All dry-type low-voltage transformers, finishes, and all of its component parts, and controls shall have an unconditional one (1) year warranty. Warranty shall include finishes and all components to be free from defects in materials and workmanship for a period of one (1) year from date of Owner's acceptance. Replacement of dry-type low-voltage transformers, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
- C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. Square D.
 - 3. General Electric Company.
 - 4. Siemens.
- B. Manufacturers shall be registered firms in accordance with ISO 9001:1994 SIC 3612 (US); which is the design and manufacture of low voltage dry type power, distribution and specialty transformers.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Copper.
- D. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degeasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use.
 - 1. 1" Minimum Clearance from Rear and Sides
- E. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and NEC standards.
- F. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- G. Cores: One leg per phase.
- H. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- I. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: Gray.
- J. Taps shall have a 5% FCAN and 10% FCBN
 - 1. 2.5% Steps On all voltages 350 V and above
 - a. 15 to 225kVA
 - b. 300kVA
 - 1) 150°C Rise
 - 2) 80°C Rise change to 5% FCBN instead of 10%
 - c. 500 and 750kVA range change to 5% FCBN instead of 10%
 - d. 1000kVA and greater per Manufacture Design
 - 2. 5% Steps On all voltages below 350 V
 - a. 15 to 225kVA
 - b. 300kVA
 - 1) 150°C Rise
 - 2) 80°C Rise change to 5% FCBN instead of 10%
 - c. 500 and 750kVA range change to 5% FCBN instead of 10%
 - d. 1000kVA and greater per Manufacture Design
- K. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- L. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- M. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

N. Wall Brackets: Manufacturer's standard brackets.

O. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.3 SHIELDED ISOLATION TRANSFORMERS

A. Provide shielded isolation transformers when serving Company Switches and Audio Video (AV) panelboards. Transformer coils shall be of the continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish.

B. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating. Cores for transformers greater than 500kVA shall be clamped utilizing insulated bolts through the core laminations to ensure proper pressure throughout the length of the core. The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.

C. Transformers shall be supplied with quality, full width electrostatic shields resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:

1. Common Mode: 0 to 1.5kHz - 120dB; 1.5kHz to 10kHz - 90dB; 10kHz to 100kHz - 65dB; 100kHz to 1MHz - 40dB
2. Transverse Mode: 1.5kHz to 10kHz - 52dB; 10kHz to 100kHz - 30dB; 100kHz to 1MHz - 30dB

2.4 Sound levels shall be warranted by the manufacturer not to exceed the following:

1. 15 to 50kVA - 39dB
2. 51 to 150kVA - 44dB
3. 151 to 300kVA - 49dB
4. 301 to 500kVA - 54dB
5. 501 to 700kVA - 56dB
6. 701 to 1000kVA - 58dB

2.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553.

2.6 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526.
- B. Connect wiring according to Section 260519.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections: Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
- E. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
- F. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 QUALITY CONTROL/STARTUP:

- A. Major equipment and system startup and operational tests shall be scheduled and documented in accordance with Section 019113 Commissioning.

3.6 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.
- 3.7 CLEANING: Vacuum dirt and debris; do not use compressed air to assist in cleaning.
- 3.8 DEMONSTRATION AND TRAINING
 - A. Training of the owner's operation and maintenance personnel is required in cooperation with the Commissioning Authority. The instruction shall be scheduled in coordination with the Commissioning Authority after submission and approval of formal training plans. Refer to Section 019113 and the Commissioning Plan for further contractor training requirements.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 262413 – LOW-VOLTAGE SWITCHBOARDPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section Includes:
 - 1. Service and distribution Switchboards rated 600 V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Accessory components and features.
 - 6. Identification.
 - 7. Mimic bus.
- B. Manufacturer shall provide Start-up Services for all Switchboards. Electrical Contractor shall schedule and complete the start-up services two (2) weeks prior to the switchboards being energized.

1.3 REFERENCES

- A. The switchboard(s) and overcurrent protection devices referenced herein are designed and manufactured according to the following appropriate specifications.
 - 1. ANSI/NFPA 70 - National Electrical Code (NEC).
 - 2. ANSI/IEEE C12.16 - Solid-State Electricity Metering.
 - 3. ANSI C57.13 - Instrument Transformers.
 - 4. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 5. NEMA PB 2 - Deadfront Distribution Switchboards, File E8681
 - 6. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
 - 7. NEMA PB 2.2 - Application Guide for Ground Fault Protective Devices for Equipment.
 - 8. UL 50 - Cabinets and Boxes.
 - 9. UL 98 - Enclosed and Dead Front Switches.
 - 10. UL 489 - Molded Case Circuit Breakers.
 - 11. UL 891 - Dead-Front Switchboards.
 - 12. UL 943 - Standard for Ground Fault Circuit Interrupters.
 - 13. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of Switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and

manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

- B. Shop Drawings: For each Switchboard and related equipment.
1. Include dimensioned plans, front and side elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 2. Conduit entrance locations and requirements; nameplate legends; one-line riser diagrams; equipment schedule; and switchboard instrument details.
 3. Detail enclosure types for types other than NEMA 250, Type 1.
 4. Detail bus configuration, current, and voltage ratings.
 5. Detail short-circuit current rating of Switchboards and overcurrent protective devices.
 6. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
 7. Detail utility company's metering provisions with indication of approval by utility company.
 8. Include evidence of NRTL listing for series rating of installed devices.
 9. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in Switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
 11. Include diagram and details of proposed mimic bus.
 12. Include schematic and wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field Quality-Control Reports:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For Switchboards and components to include in emergency, operation, and maintenance manuals. Include the following:
1. Routine maintenance requirements for Switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current coordination curves for each type and rating of overcurrent protective device included in Switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Source Limitations: Obtain Switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate space available for Switchboards including clearances between Switchboards and adjacent surfaces and other items. Equipment installed must meet all clearance, access and replacement working space requirements of the NEC and Owner.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with NFPA 70.
- G. Comply with UL 891.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver Switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Handle and prepare Switchboards for installation according to NECA 400 and NEMA PB 2.1. Lift only by lifting means provided for this express purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.
- C. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.
- D. Each switchboard section shall be delivered in individual shipping splits for ease of handling. They shall be individually wrapped for protection and mounted on shipping skids.
- E. Accept equipment on site and inspect and report concealed damage to carrier within their required time period.
- F. Store in a clean, dry space. Maintain factory protection and/or provide an additional heavy canvas or heavy plastic cover to protect structure from dirt, water, construction debris, and traffic. Where applicable, provide adequate heating within enclosures to prevent condensation.

1.10 PROJECT CONDITIONS

- A. Product Selection for Restricted Space: Drawings indicate space available for switchgear, including clearances between switchgear and adjacent surfaces and other items. Equipment installed must make all clearance, access and replacement working space requirements of the NEC and Owner.
- B. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving Switchboards into place.
- C. Environmental Limitations:
 - 1. Do not deliver or install Switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above Switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).

- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Construction Manager no fewer than 14 days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Construction Manager's written permission.
 4. Comply with NFPA 70E.

1.11 COORDINATION

- A. Coordinate layout and installation of Switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

- A. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. All low-voltage switchboards, finishes, and all of its component parts, and controls shall have an unconditional one (1) year warranty. Warranty shall include finishes and all components to be free from defects in materials and workmanship for a period of one (1) year from date of Owner's acceptance. Replacement of low-voltage switchboards, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
- C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Square D; a brand of Schneider Electric
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Siemens.
- B. Switchboards shall be service entrance labeled and listed by UL.
- C. The manufacturer of the switchboard shall be the same as the manufacturer of the circuit breakers or the switches mounted in the switchboard.
- D. All new panelboards, distribution panelboards and switchboards on this project shall be by the same manufacture as the switchboard for the purposes of stocking common breaker types, series ratings, etc.
- E. Indoor Enclosure: Steel, NEMA 250, Type 1 - General Purpose.
1. Sections shall be aligned front and rear.

2. Removable steel base channels (1.5 inch floor sills) shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.
 3. The switchboard enclosure shall be painted on all surfaces. The paint finish shall be a medium gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment.
 4. All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
 5. Top and bottom conduit areas shall be clearly indicated on shop drawings.
- F. Short Circuit Current Rating: Switchboards shall be rated with a minimum short circuit current rating of 100,000 AIC, unless otherwise indicated on Power Distribution Riser Diagram.
- G. Nominal System Voltage: As indicated on Power Distribution Riser.
- H. Main-Bus Continuous: As indicated on Power Distribution Riser.
- I. Bus Composition: Shall be silver plated, hard-drawn copper of 98% conductivity. Plating shall be applied continuously to all bus work. The switchboard bussing shall be of sufficient cross-sectional area to meet UL Standard 891 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown in the plans. For 4-wire systems, the neutral shall be of equivalent ampacity as the phase bus bar. Tapered bus is not acceptable. Full provisions for the addition of future sections shall be provided. Bussing shall include all necessary hardware to accommodate splicing for future additions.
- J. Bus Connections: Shall be bolted with Grade 5 bolts and conical spring washers.
- K. Ground Bus: Sized per NFPA70 and UL 891 Tables 25.1 and 25.2 and shall extend the entire length of the switchboard. Provisions for the addition of future sections shall be provided.
- L. Future Provisions: All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
- M. Barriers: Between adjacent switchboard sections.
- N. Insulation and isolation for main and vertical buses of feeder sections. Fire pump breakers shall be isolated per NFPA and UL requirements.
- O. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchgear.
- P. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- Q. Pull Box on Top of Switchboards:
1. Adequate ventilation to maintain temperature in pull box within same limits as switchgear.
 2. Set back from front to clear circuit-breaker removal mechanism.
 3. Removable covers shall form top, front, and sides.
 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchgear.
 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- R. Phase-, Neutral- and Ground-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with copper feeder circuit-breaker line connections.
- S. All bus bars shall extend full length of equipment to permit future additions.
- T. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
- U. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
- V. Provide equipment ground fault protection for all 3-phase, 120/208 volt for all overcurrent devices 1200 amps or greater.

- W. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 INCOMING MAIN AND TIE SECTION DEVICES

- A. Two-step stored energy electronic trip molded case circuit breaker(s)
1. Circuit protective devices shall be two-step stored energy type circuit breaker(s).
 2. Circuit breaker trip system shall be a microprocessor-based true rms sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated schedules and drawings.
 3. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
 4. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.
 5. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and switch adjustments shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 100% of their ampere rating continuously when applied in QED switchboards.
 6. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent from all other adjustments.
 - a. Long Time Pickup & Long Time Delay
 - b. Short Time Pickup & Short Time Delay (I^2t IN & I^2t OUT)
 - c. Instantaneous Pickup
 - d. Ground Fault Pickup & Ground Fault Delay (I^2t IN and I^2t OUT)
 - e. Ground Fault Alarm Only Pickup
 7. A means to seal the rating plug and trip unit adjustments in accordance with NEC Section 240-6(b) shall be provided.
 8. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
 9. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in True rms with 2% accuracy.
 10. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
 11. The trip system shall include a Long Time memory circuit to protect against intermittent overcurrent conditions above the long time pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
 12. Circuit breaker trip system shall be equipped with an externally accessible test port for use with a Universal Test Set. Provide one (1) Universal Equipment Test Set for this project job for final inspection. This test set shall be suitable for testing all electric circuit breakers specified for this project. No disassembly of the circuit breaker is required for testing.
 13. Communications capabilities for remote monitoring of circuit breakers trip system, to include phase and ground fault currents, pre-trip alarm indication, switch settings and trip history information shall be provided.
 14. Circuit breakers shall be provided with Zone Selective Interlocking (ZSI) communications capabilities on the short time and ground fault functions compatible with all other electronic trip circuit breakers and external ground fault sensing systems as noted on schedules and drawings.
 15. True two-step stored energy mechanism with five (5) cycle closing time shall be provided. All circuit breakers shall have multiple CHARGE/CLOSE provisions allowing the following sequence:
CHARGE, CLOSE, RECHARGE, OPEN/CLOSE/OPEN

16. Local control pushbuttons to OPEN and CLOSE circuit breaker shall be provided. Color coded visual indication of contact position (OPEN or CLOSED) shall be provided on the face of the circuit breaker. Local manual charging following CLOSE operation shall be provided. Color coded visual indication of mechanism CHARGED and DISCHARGED position shall be provided on the face of the circuit breaker. Visual indicator shall indicate CHARGED only when closing springs are completely charged.
17. Each circuit breaker shall be electrically operated to permit remote CHARGE, CLOSE, and OPEN capabilities. Electrically operated circuit breaker shall be equipped with charge contact switch for remote indication of mechanism charge status.
18. All circuit breakers shall be equipped with electrical accessories as noted on schedules and drawings.
19. Provide the following interlocking capabilities:
 - a. cell door interlock
 - b. key interlock for main-tie-main
 - c. lock off
20. Equipment Ground Fault Protection
 - a. Circuit breaker(s) shall be provided with integral equipment protection for grounded systems.
 - b. The ground fault system shall be of the residual type.
 - c. Circuit breaker(s) shall be provided with zone selective interlocking (ZSI) on the Ground Fault function in order to limit thermal stress caused by a fault, yet permit optimum coordination with all other electronic trip circuit breakers.
21. Terminations
 - a. All lugs shall be UL Listed to accept solid and/or stranded copper conductors only.
 - b. All circuit breakers shall be UL Listed to accept field installable/removable lugs.

2.3 DISTRIBUTION SECTION DEVICES

A. Group mounted circuit breakers through 1200A

1. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
2. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
3. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.
4. Line-side circuit breaker connections are to be jaw type.
5. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
6. Electronic trip molded case standard function 80% rated circuit breakers
 - a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
 - b. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated schedules and drawings.

- c. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
- d. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.
- e. All feeder breakers to be ZSI, Zone Selective Interlocking.

B. Individually mounted circuit breakers through 4000A

- 1. Electronic trip molded/insulated case full function 100% rated circuit breaker(s) through 4000A.
 - a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
 - b. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated schedules and drawings.
 - c. Local visual trip indication for overload, short circuit and ground fault trip occurrences.
 - d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
 - e. Communications capabilities for remote monitoring of circuit breaker trip system, to include phase and ground fault currents, pre-trip alarm indication, switch settings, and trip history information shall be provided.
 - f. Circuit breaker shall be provided with Zone selective Interlocking (ZSI) communications capabilities on the short-time and ground fault functions compatible with all other electronic trip circuit breakers and external ground fault sensing systems as noted on schedules and drawings.
 - g. All individually mounted feeder breakers above 1200 amps to be fixed mounted.
 - h. All feeder breakers to be ZSI, Zone Selective Interlocking.

2.4 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer, if required.
- B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for #8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchgear. Include relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.
- C. Overhead Circuit Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each draw-out circuit breaker.
- D. Lock-out, Tag-out: All circuit breakers in the Switchboard to include fixed padlock attachments.

2.6 METERING

- A. Square D Model PM5563 or approved equal. Install in face of switchboard.

2.7 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for Switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine area to receive switchboard to provide adequate clearance for switchboard installation.
- B. Check that concrete pads are level and free of irregularities.
- C. Start work only after unsatisfactory conditions are corrected.

3.2 EXAMINATION

- A. Receive, inspect, handle, and store switchgears according to NECA 400 and NEMA PB 2.1.
- B. Examine Switchboards before installation. Reject Switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive Switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install Switchboards and accessories according to manufacturer's written guidelines, NECA 400 and NEMA PB 2.1.
- B. Equipment Mounting: Install Switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to Switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from Switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for Switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of Switchboards.
- E. Install filler plates in unused spaces of panel-mounted sections.
- F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- G. Comply with NECA 1.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553, "Identification for Electrical Systems".

- B. Switchboard Nameplates: Label each Switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553, "Identification for Electrical Systems".
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553, "Identification for Electrical Systems".

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each Switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. For all breakers with 250A frame and larger perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each Switchboard.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each Switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - d. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
 - 4. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
 - 5. Measure, using a Megger, the insulation resistance of each bus section phase-to-phase and phaseto-ground for one minute each, at minimum test voltage of 1000 VDC; minimum acceptable value for insulation resistance is 1 megohms. NOTE: Refer to manufacturer's literature for specific testing procedures.
 - 6. Check tightness of accessible bolted bus joints using calibrated torque wrench per manufacturer's recommended torque values.
 - 7. Physically test key interlock systems to check for proper functionality.
 - 8. Test ground fault systems by operating push-to-test button.
- E. Switchboard will be considered defective if it does not pass tests and inspections.

3.6 QUALITY CONTROL/STARTUP

- A. Prepare test and inspection reports, including a certified report that identifies Switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Tighten bolted bus connections in accordance with manufacturer's instructions.
- B. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- C. Set field-adjustable circuit-breaker trip ranges and time delay settings to recommended values in the Overcurrent Protective Device Coordination Study. Refer to 260573, "Electrical Studies".

3.8 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.
- B. Touch-up scratched or marred surfaces to match original finish.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain Switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.
- B. Training of the owner's operation and maintenance personnel is required in cooperation with the Commissioning Authority. The instruction shall be scheduled in coordination with the Commissioning Authority after submission and approval of formal training plans. Refer to Section 019113 and the Commissioning Plan for further contractor training requirements.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 262416 - PANELBOARDSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards
 - 2. Lighting and appliance branch-circuit panelboards

1.3 DESCRIPTION OF WORK

- A. All panelboards shall be of the circuit breaker type, and shall be of one manufacturer.
- B. Branch panelboards shall be as indicated on the drawings and as specified herein. The lighting panelboards shall be of the dead-front, quick-make, quick-break, bolt-on circuit breaker type, with trip indicating and trip free handles. All circuits shall be clearly and properly numbered and shall be provided with thermal magnetic protection.
- C. The panelboards shall be enclosed in code gauge, galvanized steel cabinets with smooth finished hinged doors without visible external fasteners and heavy chrome locks. Provide baked-on grey enamel finish, in accord with ANSI 61. Panels shall be constructed in accord with Federal Specification W-P-115B Type 1 Class 1, UL67, UL50, NEMA P31, and NFPA 70. Locks shall all be keyed alike.
- D. Each door shall have a directory card inside, covered with a plastic shield, with typewritten circuit numbers and description indicated. Room numbers shall be coordinated with final room numbers as selected by Owner, not numbers on Contract Documents.
- E. Panelboard trim for surface or flush panels shall be double-hinged type, to allow exposure of dead-front breaker portion behind locked door, with screw-fastened gutter trim that is hinged to allow full access to wiring gutters.
- F. Special Note: The room numbers used to fill out the panel directories shall match the actual final name and numbering scheme selected by the Owner. They shall not be filled out per the construction drawing numbering scheme, unless the Contractor is directed to do so by the Architect or Engineer.
- G. Branch panelboards shall be surface or flush mounted as indicated on the Contract Drawings. Flush panels trims shall be tight to wall and interior barriers, with no gaps allowing access to live parts. Oversize trims will not be acceptable.
- H. Note: Where mounted in groups, align top of trim or tub for all panels in an area. Exact mounting height of topline shall be as directed by the Engineer.
- I. All main bus and connections thereto in panelboards shall be copper. All bus bars shall extend full length of panelboards.

- J. All panelboards shall have full size un-insulated copper ground busses and insulated full neutral busses.
- K. All panelboards shall be provided with an SPD per Specification 264313, Surge Protection for Low-Voltage Electrical Power Circuits.

1.4 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. GFCI: Ground-fault circuit interrupter

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, surge suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for panelboards and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each panelboard cabinet lock. All keys shall match.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate space available for panelboards including clearances between panelboards and adjacent surfaces and other items. Furnish and install equipment to comply with NEC clearances.

- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - E. Comply with NEMA PB 1.
 - F. Comply with NFPA 70.
- 1.9 DELIVERY, STORAGE, AND HANDLING
- A. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.
- 1.10 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than 14 days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Construction Manager's written permission.
 - 3. Comply with NFPA 70E.
- 1.11 COORDINATION
- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
 - B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- 1.12 WARRANTY
- A. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
 - B. All panelboards, finishes, and all of its component parts, and controls shall have an unconditional one (1) year warranty. Warranty shall include finishes and all components to be free from defects in materials and workmanship for a period of one (1) year from date of Owner's acceptance. Replacement of panelboards, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
 - C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.
 - D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace surge suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- 1.13 SYSTEM COMMISSIONING

- A. Section 019113 requires the engagement of a Commissioning Authority to document the completion of the Mechanical, Fire Protection, Plumbing, Electrical, Electronic Safety and Security, and associated Control Systems for the project. Section 019113 defines the roles and responsibilities of each member of the commissioning team.
- B. Comply with the requirements of Section 019113 for the commissioning of the various building systems.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. All panelboards shall be of the circuit breaker type, and shall be of one manufacturer.
- B. Enclosures: Flush- and surface-mounted cabinets. Box width shall not exceed 20" wide. Rated for environmental conditions at installed location.
 - 1. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Kitchen and Catering Areas: NEMA 250, Type 4X, Stainless Steel.
- C. Type 1 Boxes
 - 1. Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel is not acceptable.
 - 2. Boxes shall have removable end walls. End walls shall not be provided with concentric knockouts. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 6. Finishes: Panels, Back Boxes and Trim: Galvanized Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - 7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
 - 8. All lock assemblies shall be keyed alike.
- D. Incoming Mains Location: Top and bottom to match feeder conduit entry. Feeders routed through the side gutters to reach the top or bottom main breakers from the opposite end of the panel are not acceptable.
- E. Phase, Neutral, and Ground Busses:
 - 1. Material: Fully plated, hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Extend full length of panelboard and adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box. Provide where show on drawings.
 - 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads. Provide when supplied by K rated transformers.
 - 5. Split Bus: Vertical busses divided into individual vertical sections.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Main and Neutral Lugs: Mechanical type.
 - 2. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 3. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

4. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 5. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Square D; a brand of Schneider Electric.
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Siemens.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Square D; a brand of Schneider Electric.
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Siemens.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- E. Interior:
1. Continuous main current ratings, as indicated on associated drawings.
 2. Short circuit rating as shown on the schedules.
 3. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing shall be plated copper. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
 4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
 5. A solidly bonded copper equipment ground bar shall be provided.

6. Split solid neutral shall be plated and located in the mains compartment up to 250 amperes so all incoming neutral cable may be of the same length.
7. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have filler plates covering unused mounting space.
8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, CSA/UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Square D; a brand of Schneider Electric.
 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Circuit breakers shall be CSA and UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the panelboard schedules.
 2. Molded case branch circuit breakers shall have bolt-on type bus connectors.
 3. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
 4. There shall be two forms of visible trip indication. The circuit breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red indicator appearing in the clear window of the circuit breaker housing.
 5. The exposed faceplates of all branch circuit breakers shall be flush with one another.
 6. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors.
 7. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 8. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 9. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 10. Instantaneous trip.
 11. Long- and short-time pickup levels.
 12. Long- and short-time time adjustments.
 13. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 14. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 15. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 16. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 17. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - d. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

- e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- B. Equipment Mounting: Install floor-mounted panels on concrete bases, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
 - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed. Set field-adjustable, circuit-breaker trip ranges.
- G. Install filler plates in unused spaces.
- H. Stub four (4) 1-inch and two (2) 1-1/4"-inch empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- J. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Each door shall have a directory card inside, covered with a plastic non-yellowing shield. Directory Card to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer to create directory in Microsoft Excel; handwritten directories are not acceptable. Digital versions to be provided to Owner.
- B. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553.
- C. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553.

3.4 QUALITY CONTROL/STARTUP: Major equipment and system startup and operational tests shall be scheduled and documented in accordance with Section 019113 Commissioning.

- A. Functional Performance Tests: System functional performance testing is part of the Commissioning Process as specified in Section 019113. Functional performance testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority.
- B. Demonstration and Training: Training of the owner's operation and maintenance personnel is required in cooperation with the Commissioning Authority. The instruction shall be scheduled in coordination with the Commissioning Authority after submission and approval of formal training plans.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.7 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 262726 - WIRING DEVICES AND PLATESPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. This section of the specifications covers all wiring devices and cover plates, standard, weatherproof and dust-tight.
- B. Wiring devices, listed by manufacturer and catalogue numbers are to establish the quality and type required. Equivalent devices of other manufacturers will be acceptable with prior approval of the Engineer. Submit cutsheets and/or samples of each type ten days prior to bid date for review and written approval to bid. Insofar as possible, standard application or special application devices shall be by one manufacturer.
- C. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge-suppression units.
 - 4. Isolated-ground receptacles.
 - 5. Tamper-resistant receptacles.
 - 6. Weather-resistant receptacles.
 - 7. Snap switches and wall-box dimmers.
 - 8. Cord and plug sets.
 - 9. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENT

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.8 SYSTEM COMMISSIONING

- A. Section 019113 requires the engagement of a Commissioning Authority to document the completion of the Mechanical, Fire Protection, Plumbing, Electrical, Electronic Safety and Security, and associated Control Systems for the project. Section 019113 defines the roles and responsibilities of each member of the commissioning team.
- B. Comply with the requirements of Section 019113 for the commissioning of the various building systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 2. Leviton Mfg. Company Inc. (Leviton).
 - 3. Pass & Seymour/Legrand (P&S).
 - 4. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Straight-Blade Receptacles
 - 1. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 2. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - a. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
 - 3. Tamper-Resistant, Shutter-Type Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

D. SPD Receptacles

1. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 1449, and FS W-C-596, with integral SPD in line to ground, line to neutral, and neutral to ground.
 - a. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
 - b. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
2. Duplex SPD Convenience Receptacles: Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
3. Isolated-Ground, Duplex Convenience Receptacles:
 - a. Straight blade, 125 V, 20 A; NEMA WD 6 Configuration 5-20R.
 - b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.3 DEVICES

| TYPE | RATING | CONFIGURATION | COLOR | VENDOR - CAT. # |
|--|--|---------------|-------|---|
| RECEPTACLE, DUPLEX PREMIUM GRADE | 125V, 20A | NEMA 5-20R | ! | HUBBELL 5352 LEVITON or P & S Equal |
| | * USE WHERE ON DEDICATED 20A CKT., OR CALLED OUT ** USE WHERE ON DEDICATED 15A CKT., OR WHERE MORE THAN ONE RECEPTACLE ON A CIRCUIT | | | |
| RECEPTACLE, SAFETY SHUTTER TYPE DUPLEX | 125V, 20A | NEMA 5-20R | ! | HUBBELL, LEVITON, or P & S equal |
| RECEPTACLE, DUPLEX GFI WITH AUDIBLE ALARM | 125V, 20A | NEMA 5-20R | ! | P & S 2095 TRAN LEVITON or HUBBELL equal |
| RECEPTACLE, DUPLEX, WEATHER RESISTANT, GFI | 125V, 20A | NEMA 5-20R | ! | HUBBELL # GFTR20 LEVITON #W7599TRE OR P & S Equal |
| RECEPTACLE, SIMPLEX | 125V, 20A | NEMA 5-20R | ! | HUBBELL 5361 |
| RECEPTACLE, SINGLE | 250V, 20A | NEMA 10-20R | BLACK | HUBBELL 6810 LEVITON or P & S Equal |
| RECEPTACLE, SINGLE | 250V, 30A | NEMA 6-30R | BLACK | HUBBELL 9330 LEVITON or P & S Equal |

| | | | | |
|---|---------------|------------|-------|---|
| RECEPTACLE, SINGLE | 250V, 50A | NEMA 6-50R | BLACK | HUBBELL 9367 LEVITON or P & S Equal |
| SWITCH, SINGLE POLE | 120/277V, 20A | SPST | ! | HUBBELL HBL-1221 LEVITON or P & S Equal |
| SWITCH, THREE-WAY | 120/277V, 20A | 3-WAY | ! | HUBBELL HBL-1223 LEVITON or P & S Equal |
| <p>NOTES:</p> <ol style="list-style-type: none"> 1. PROVIDE MATCHING CAP (PLUG) FOR ALL RECEPTACLES 30 AMP RATED AND ABOVE AS REQUIRED FOR EQUIPMENT. 2. ALL RECEPTACLES SHALL BE BACK OR SIDE-WIRED, CLAMPING TYPE 3. RECEPTACLES SHALL BE TAMPER RESISTANT AND WEATHER RESISTANT AND MARKED ACCORDINGLY AS REQUIRED BY NEC <p>! SEE PART 2.5, COLOR.</p> | | | | |

2.4 SMALL MOTOR CONTROL SWITCHES

- A. For small line-to-neutral motor loads of 3/4 HP or less, single phase, rated at 120 or 277 volts, provide snap-type, HP rated motor starter switch with thermal overloads. Overload heaters sized to match the motor nameplate amperes and the ambient temperature shall be provided. Provide with NEMA 1, NEMA 3R or other enclosure suitable for the location and atmosphere. All manual starters in finished areas shall be in flush-mounted enclosures. If the motor to be controlled is not equipped with internal thermal overload protection, overload heaters sized to match the motor nameplate amperes and the ambient temperature shall be provided. Hubbell, Square D or GE.

2.5 COLOR

- A. Color of devices shall be as selected by the architect. Outlets shown as "SP" or "SS" shall be blue. Samples (devices, plates or both) may be required to be submitted with other architectural color items by the Contractor. The Contractor shall coordinate any such submission required with other trades, the Prime Contractor or as needed.
- B. Where devices are controlling or supplying emergency power from a standby source, the device color shall be red, as with switch toggles or receptacle fronts. Plate color shall match others on normal power in the building unless otherwise noted.
- C. Where surface finishes next to the devices vary in color or shade throughout the project, the Contractor may be required to provide lighter or darker plates and devices to more closely match wall finishes. These variations are considered to be included in the original contract for construction.

2.6 PLATES AND COVERS

- A. Unless otherwise specified or noted, all wiring device plates and covers shall be 304 stainless steel. Plates shall have circuit and panel designation engraved in the face.
- B. Plates for use on emergency outlets shall be engraved with the word "Emergency". Plates for use on isolated ground outlets shall be engraved with the words "Isolated Ground".
- C. Cover plates shall be of one manufacturer insofar as possible.

- D. Weatherproof, while in-use, plates for GFCI receptacles shall be cast aluminum, self-closing, gasketed, suitable for standard box mounting, UL listed for wet location use, cover closed. Vertical mounting - Hubbell WP26M, horizontal mounting - Hubbell WP26MH (die-cast zinc) or equivalent Leviton or P & S.
- E. Weatherproof switch plates for toggle-handle switches shall be clear silicone rubber, for standard outlet boxes. Hubbell 1795 or equivalent P & S or Leviton.
- F. Cover plates for computer, telephone or other system outlets shall be as color and finish to match receptacle plates in each space specified in other sections.
- G. All kitchen and food service area plates shall be smooth 304 stainless steel with foam gasket behind to help prevent water infiltration.

2.7 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Model numbers indicated on floor plans is basis-of-design. Subject to compliance with requirements, provide products by one of the following approved manufacturers:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Pass & Seymour/Legrand.
 - 3. Square D/Schneider Electric.
 - 4. Thomas & Betts Corporation.
 - 5. Wiremold/Legrand.
- B. Description:
 - 1. Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
 - 2. Comply with UL 514 scrub water exclusion requirements.
 - 3. Size: Selected to fit nominal 8-inch cored holes in floor and matched to floor thickness.
 - 4. Fire Rating: Unit is listed and labeled for 2-hour fire rating of floor-ceiling assembly.
 - 5. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.

2.8 FLOOR BOXES

- A. Manufacturers: Model numbers indicated on floor plans is basis-of-design. Subject to compliance with requirements, provide products by one of the following approved manufacturers:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Pass & Seymour/Legrand.
 - 3. Square D/Schneider Electric.
 - 4. Thomas & Betts Corporation.
 - 5. Wiremold/Legrand.
- B. Description:
 - 1. In general, floor boxes that are to contain multiple services such as power, data, voice, video, etc., shall be constructed of stamped steel and heavy thermoplastic with barriers or compartments to separate power from signal services per National Electrical Code.
 - 2. Provide floor boxes with proper trim for carpet, wood, terrazo, tile or concrete floors, wiring slots, dust covers and proper device plates to hold outlets, jacks, etc. They shall be fully adjustable. Conduit rough-in shall be as required. All tops shall be capable of receiving an insert of the surrounding floor material.
 - 3. Outlets for multi-service floor boxes shall be as specified elsewhere in these specifications.
 - 4. Set boxes dead level with flooring and provide proper support by thickening concrete slab, welding angle iron across joists below or other approved means.

2.9 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
- C. Description:
 - 1. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
 - 2. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.10 PENDANT CORD-CONNECTOR DEVICES

- A. Description:
 - 1. Matching, locking-type plug and receptacle body connector.
 - 2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
 - 3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
 - 4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.11 CORD AND PLUG SETS

- A. Description:
 - 1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
 - 3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. All wiring devices in dusty areas, exposed to weather and moisture shall be installed in Type "FS" conduit fittings having mounting hubs, with appropriate cover plates.
- C. Devices that have been installed before painting shall be masked. No plates or covers shall be installed until all finishing and cleaning has been completed.
- D. Provide GFCI duplex feed-thru style receptacles where indicated or required by the National Electrical Code, whether specifically called out or not. When a GFCI receptacle is on a circuit with other non-GFCI receptacles, it shall always be placed at the homerun point of the circuit and shall be wired to ground-fault interrupt protect the downstream outlets on that circuit unless specifically indicated to the contrary. Provide a "GFCI protected" label on each downstream outlet. GFCI receptacles shall audibly alarm when tripped.
- E. All receptacles shall be installed with ground prong at bottom position.
- F. All device face plates shall be labeled with panel and circuit designation by means of machine printed adhesive tape. Select face plates shall be engraved. Refer to drawings.
- G. All device boxes shall have circuit number identified within the box.

- H. Coordination for all receptacles except NEMA 5 Configuration: Contractor shall confirm receptacle configuration of all special purpose receptacles prior to installation and provide devices to match equipment. Contractor shall replace any incompatible receptacle discovered during owner move-in.
- I. Coordination with Other Trades:
1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- J. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
- K. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
 5. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 6. When conductors larger than #12 AWG are installed on 15- or 20-A circuits, splice #12 AWG pigtails for device connections.
 7. Tighten unused terminal screws on the device.
 8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
 9. Install switches with "OFF" position down.
- L. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- M. Dimmers:
1. Install slide type dimmers within terms of their listing. Dimmers shall match load type.
 2. Verify that dimmers used for fan speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to NEC and manufacturers' device listing conditions in the written instructions.
- N. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- 3.2 IDENTIFICATION: Comply with Division 26 Section "Identification for Electrical Systems.
- 3.3 FIELD QUALITY CONTROL
- A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Wiring device will be considered defective if it does not pass tests and inspections.
- C. Tests for Convenience Receptacles:
1. Line-Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 262813 - FUSESPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers and motor-control centers.
 - 2. Spare fuse cabinet.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Let-through current curves for fuses with current-limiting characteristics.
 - 3. Time-current curves, coordination charts and tables, and related data.
 - 4. Fuse size for elevator feeders and elevator disconnect switches.
- B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - 1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - 2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
- C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with:
 - 1. NEMA FU 1 – Low Voltage Cartridge Fuses.
 - 2. NFPA 70 – National Electrical Code.
 - 3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
 - 4. UL 198E – Class R Fuses.
 - 5. UL 512 – Fuseholders.

1.5 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Fuses: Equal to ten (10) percent of quantity installed for each size and type, but no fewer than three of each size and type.
- C. Fuse Pullers: Two (2) for each size and type.

1.7 WARRANTY

- A. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace fuses that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Owner's acceptance.

1.8 PROJECT CONDITIONS

- A. A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Ferraz Shawmut, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
- B. Voltage: Rating suitable for circuit phase-to-phase voltage.

2.3 FUSE APPLICATIONS

- A. Circuits 601 to 6000 amperes shall be protected by current limiting BUSSMANN HI-CAP TIME DELAY FUSES KRP-C. Fuses shall employ "O" rings as positive seals between the end bells and the fuse barrel. Fuses shall be a time-delay type and must hold 500% of rated current for a minimum of 5 seconds, clear 20 times rated current in .01 seconds or less and be listed by Underwriter's Laboratories, Inc., with an interrupting rating of 200,000 amperes RMS symmetrical. The fuses shall be UL Class L.
- B. Circuits 0 to 600 amperes shall be protected by current limiting BUSSMANN LOW-PEAK Dual Element Fuses, LPN-RK (250 volts) or LPS-RK (600 volts). All dual element fuses shall have separate overload and short circuit elements. Fuse shall incorporate a spring activated thermal overload element having a 284NF melting point alloy and shall be independent of the short-circuit clearing chamber. The fuse shall hold 500% of rated current for a minimum of 10 seconds and be listed by Underwriters Laboratories, Inc. with an interrupting rating of 200,000 amperes RMS symmetrical. The fuses shall be UL Class RK1.
- C. Motor Circuits - All individual motor circuits rated 480 amperes or less shall be protected by BUSSMANN LOW PEAK DUAL-ELEMENT FUSES LPN-RK (250 volts) or LPS-RK (600 volts). The fuses for 1.15 service factor motors shall be installed in rating approximately 125% of motor full load current except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions the fuse should be 150% to 200% of the Type KRP-C HI-CAP Time Delay Fuses of the rating shown on the drawings. 1.0 service factor motors shall be protected by BUSSMANN LOW-PEAK Dual-Element Fuses LPN RK (250 volts) or LPS-RK (600 volts) installed in rating approximately 115% of the motor full load current except as noted above. The fuses shall be UL Class RK1 or L.
- D. Circuit breaker panels shall be protected by BUSSMANN LOW-PEAK Dual Element fuses LPN-RK (250 volts) or LPS-RK (600 volts) as shown on the drawings. The fuses shall be UL Class RK1.

2.4 LIGHTING BALLAST/DRIVER/TRANSFORMER FUSES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Bussman, Inc. – GLR fuses with HLR holder.
 2. Tracor, Inc.; Littelfuse, Inc. Subsidiary – LGR fuses with LHR-000 holder.
 3. Ferraz Shawmut, Inc. – SLR fuses.
- B. Provide each lighting ballast/driver/transformer with individual protection on the line side.
- C. Provide fuse and holder mounted within or as part of the fixture.
- D. Provide fuse size and type recommended by the fixture manufacturer.

2.5 SPARE-FUSE CABINET

- A. Manufacturer: Bussmann #SFC-FUSE-CAB spare fuse cabinet or equal.
- B. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
- C. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
- D. Finish: Gray, baked enamel.
- E. Identification: "SPARE FUSES" in 1-1/2 inch high white letters on black lamicoide plate. Mount plate on exterior of door.
- F. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Fuses shall be installed when equipment is ready to be energized, including thorough cleaning and tightening of all electrical connections.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energizing at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energizing of the circuit in which it is applied.
- B. No fuses shall be installed in the equipment until the installation is complete, including tests and inspections required prior to being energized. All fuses shall be of the same manufacturer to insure retention of selective coordination, as designed.
- C. Provide a complete set of fuses for all fusible devices. Arrange fuses so rating information is readable without removing fuse.
- D. Install spare-fuse cabinet(s). Locate in Main Electrical Room.
- E. Upon completion of the building, the Contractor shall provide the Owner with spare fuses in Spare-Fuse Cabinet.

3.3 IDENTIFICATION

- A. Install as part of the lamicaid identification labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION 262813

DIVISION 26 – ELECTRICALSECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section includes:
 - 1. Fusible Switches
 - 2. Non-Fusible Switches
 - 3. Individually Mounted Circuit Breakers
 - 4. Combination Starter/Disconnect Switches
 - 5. Enclosures.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter
- B. HD: Heavy Duty

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- B. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches, circuit breakers, accessory, and component indicated from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate space available for enclosed switches including clearances between enclosed switches and adjacent surfaces and other items. Furnish and install equipment to comply with NEC clearances.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 WARRANTY

- A. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. All enclosed switches and circuit breakers, finishes, and all of its component parts, and controls shall have an unconditional one (1) year warranty. Warranty shall include finishes and all components to be free from defects in materials and workmanship for a period of one (1) year from date of Owner's acceptance. Replacement of enclosed switches and circuit breakers, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
- C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.
- D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace surge suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 4. Siemens.

2.2 NON-FUSIBLE SWITCHES

- A. All non-fusible safety switches shall be Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. All safety switches shall have switch blades that are fully visible in the "OFF" (open) position with the door open.
- C. All safety switches shall have a factory installed ground lug.
- D. All safety switches shall have a factory installed neutral lug, when a neutral is necessary.

- E. All current carrying parts shall be plated by an electrolytic process to resist corrosion and to promote cooling.
- F. Switch mechanism shall be quick-make, quick-break, load break rated, such that during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing and opening action of the contacts has started. The handle and mechanism shall be an integral part of the box (not cover) with facilities for pad locking in the open or closed position with up to three padlocks. Switch doors shall be interlocked with switch handle so that the door can only be opened when the switch is in the "OFF" (open) position.
- G. Provide the following Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 FUSIBLE SWITCHES

- A. All fusible safety switches shall be Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. All safety switches shall have switch blades that are fully visible in the "OFF" (open) position with the door open.
- C. All safety switches shall have a factory installed ground lug.
- D. All safety switches shall have a factory installed neutral lug, when a neutral is required.
- E. All current carrying parts shall be plated by an electrolytic process to resist corrosion and to promote cooling.
- F. Switch mechanism shall be quick-make, quick-break, load break rated, such that during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing and opening action of the contacts has started. The handle and mechanism shall be an integral part of the box (not cover) with facilities for pad locking in the open or closed position with up to three padlocks. Switch doors shall be interlocked with switch handle so that the door can only be opened when the switch is in the "OFF" (open) position.
- G. Provide the following Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 INDIVIDUALLY MOUNTED MOLDED-CASE CIRCUIT BREAKERS

- A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- B. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- C. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
- D. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- E. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- F. Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

2.5 COMBINATION STARTER/DISCONNECT SWITCHES

- A. All combination starter/disconnect switches shall be full-voltage, non-reversing type.
- B. All combination starter/disconnect switches shall have low-voltage protection, solid state overloads, Hands-Off-Auto selector switch and Red and Green pilot lights.
- C. All combination starter/disconnect switches shall be Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Combination motor starters shall be rated in accordance with NEMA sizes and horsepower ratings. No starter shall be listed as a fractional size.
- E. Contactor contacts shall be silver alloy, double break, and shall allow for inspection on NEMA Sizes 00 through 4 without the use of tools. Size 5 and larger shall allow for inspection utilizing standard tools. They shall be replaceable without removing the line, load, or control wiring from the starter, and replaceable without removing the starter from the enclosure.
- F. Contactor coils shall be the encapsulated type, and shall be replaceable on NEMA Sizes 00 through 4 without the use of tools. Size 5 and larger shall be replaceable with standard tools. They shall be replaceable without removing the line, load, or control wiring from the starter, and replaceable without removing the starter from the enclosure.
- G. Overload protection shall be provided by solid state electronic overload relay. Single-phase starters shall provide one- or two-leg overload protection; three-phase starters shall provide three-leg overload protection.
- H. Combination starter shall be suitable for straight through wiring.
- I. Switch mechanism shall be quick-make, quick-break, load break rated, such that during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing and opening action of the contacts has started. The handle and mechanism shall be an integral part of the box (not cover) with facilities for pad locking in the open or closed position with up to three padlocks. Switch doors shall be interlocked with switch handle so that the door can only be opened when the switch is in the "OFF" (open) position.
- J. All safety switches shall have a factory installed ground lug.
- K. All safety switches shall have a factory installed neutral lug, when a neutral is necessary.
- L. All current carrying parts shall be plated by an electrolytic process to resist corrosion and to promote cooling.
- M. Provide the following Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.6 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Securely fasten each switch, circuit breaker and combination starter to the supporting structure or wall, utilizing a minimum of four (4) 1/4 inch bolts. Do not mount in an inaccessible location or where the passageway to the switch may become obstructed.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Electrical Studies".

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 262913 –MOTOR STARTERSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.
- D. This section is a Electrical Division Basic Materials and Methods section, and is part of each Division 26 section making reference to motor starters specified herein. Refer to Mechanical Division for further requirements.

1.2 DESCRIPTION OF WORK:

- A. Extent of motor starter work is indicated by drawings and schedules.
- B. Types of motor starters in this section include the following: Manual. Full voltage, non-reversing.

1.3 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacturer of motor starters, of types, ratings and characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: Qualified with at least 5 years of successful installation experience on projects with electrical installation work similar to that required for the project.
- C. NEC Compliance: Comply with NEC as applicable to wiring methods, construction and installation of motor starters.
- D. UL Compliance and Labeling: Comply with applicable requirements of UL 508, "Electrical Industrial Control Equipment", pertaining to electrical motor starters. Provide units which have been UL listed and labeled.
- E. NEMA Compliance: Comply with applicable portions of NEMA standards pertaining to motor controllers/starters and enclosures.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's data on motor starters.
- B. Shop Drawings: Submit dimensioned drawings of motor starters showing accurately scaled equipment layouts and spatial relationship to associated motors, and connections to electrical power panels and feeders.
- C. Maintenance Data: Submit maintenance instructions for motor and drive replacement, and spare parts lists. Include this data in maintenance manuals.
- D. Maintenance Stock, Fuses: For types and ratings required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 5 units of each. Fuses shall be of a type available from at least two manufacturers.

- E. Maintenance Stock overloads; for each type and rating required, furnish additional overloads, amounting to one unit for each nine installed, but not less than three units of each.

1.5 WARRANTY

- A. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- B. All motor starters, finishes, and all of its component parts, and controls shall have an unconditional one (1) year warranty. Warranty shall include finishes and all components to be free from defects in materials and workmanship for a period of one (1) year from date of Owner's acceptance. Replacement of motor starters, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.
- C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter): Furnas Electric Co., Allen Bradley Co., Square D. Co.

2.2 MOTOR STARTERS:

- A. General: Except as otherwise indicated, provide motor starters and ancillary components; of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installations. Where more than one type of equipment meets indicated requirements, selection is Installer's option. Provide phase loss and low voltage protection relay in the control circuit of all motors 7-1/2 HP and larger. Starters shall be a minimum of size 1 with solid state overloads, phase failure and low voltage protection, control transformers, hand-off-auto selector, and red and green pilot light. Provide fixed (.6-10 second) time delay electronic relay in control circuit of all motors, 7-1/2 HP and larger, connected to the essential electrical system. This includes starters for motor control centers also.
- B. Control transformers shall be individually fused from the line side with two cartridge fuses and one fuse on the secondary. Size transformers for holding coil circuit current and all other connected loads.
- C. AC Fractional HP Manual Starters: Provide manual single phase fractional HP motor starters, of types, ratings and electrical characteristics indicated; equip with thermal overload relay for protection of 120 volt AC motors of 2 HP and less. Provide starters with quick-make, quick-break trip free toggle mechanisms. Mount starter in NEMA Type 1 general purpose enclosure.
- D. A.C. Full Voltages: Provide full voltage alternating current magnetic starters, consisting of contactors and solid state overloads mounted in common enclosures; of type, size, ratings and NEMA sizes indicated. Control voltage to be 120V with a minimum of 2 sets of auxiliary contact, (one - N.O. and one N.C.) or as required for controls specified. Provide other control components such as H.O.A. switches, pushbuttons, pilot lights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store motor starters according to NECA 407.
- B. Examine motor starters before installation. Reject motor starters that are damaged or rusted or have been subjected to water saturation.

- C. Examine elements and surfaces to receive motor starters for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF MOTOR STARTERS:

- A. Install motor starters as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC, NEMA standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Install fuses in fusible disconnects, if any.
- C. Install overloads, sized to provide protection in accordance with the manufacturers recommendations and the N.E.C. in overload relays.

3.3 ADJUST AND CLEAN:

- A. Inspect operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finish.

3.4 FIELD QUALITY CONTROL:

- A. Subsequent to wire/cable hook-up, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION.

DIVISION 26 – ELECTRICALSECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITSPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. The Contractor shall provide the necessary labor, materials, wiring and services necessary to provide the complete electrical surge protection systems as specified herein. This work shall include, but is not necessarily limited to:
- C. Provision of Surge Suppression Units at certain points in the power distribution network and on telephone and television service lines.
- D. Proper installation of surge suppression unit(s), in accord with shop drawings. Wiring routing, grounding and all connections shall be in exact accord with manufacturer's recommendations.

1.3 DEFINITIONS

- A. MCOV: Maximum continuous operating voltage.
- B. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- C. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- D. OCPD: Overcurrent protective device.
- E. SCCR: Short-circuit current rating.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data, for each type of product, on surge protection systems and components as part of shop drawing submissions. Indicate all capacity ratings, clamp times, maximum capacities, physical construction and listing agency approvals. Submittals shall include UL 1449, 3rd Edition Listing documentation verifying:
 - 1. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.
 - 2. Short Circuit Current Rating (SCCR).

3. Voltage Protection Ratings (VPRs) for all modes.
4. Maximum Continuous Operating Voltage rating (MCOV). The MCOV shall be a tested value per UL1449 3rd Edition, section 37.7.3. MCOV values bases solely on the components used in the construction of the SPD will not be accepted.
5. I-nominal rating (I-n).
6. Type 1 or Type 2 Device Listing.
7. Manufacturer shall provide written test report showing the SPD can survive a single surge at its rated value without the use of circuit breakers or fuses.
8. kA rating per phase.
9. kA rating per mode.

B. Submittals shall also include the following:

1. Line drawings detailing dimensions and weight of enclosure.
2. Listing and rating of all modes of protection in each type of SPD required.
3. Breaker sizes used for SPD service disconnects.
4. Wiring diagram showing all manufacturer installed wiring including wire size, type, routing, and exact length of conductors.
5. Listing of equipment where each type of SPD is installed.

C. Maintenance Data: Submit maintenance instructions for surge suppression system. Include this data in Operation and Maintenance manuals.

1.5 QUALITY ASSURANCE

A. STANDARDS – Most Recent Edition of

1. Underwriters Laboratories: UL1449, 3RD Edition
2. ANSI/IEEE C62.41.1-2002, C62.41.2-2002, C62.45-2002
3. National Electrical Code: Article 285

B. Manufacturer shall be regularly engaged in production of surge protection equipment of types, sizes and ratings required, whose products have been satisfactorily used in similar service for not less than three years.

C. LISTING REQUIRMENTS: Comply with NEC and NFPA requirements, as applicable to materials and installation of surge protection components and wiring. Surge protection equipment shall be UL listed and labeled for its intended use. “Manufactured in accordance with” is not equivalent to UL listing and does not meet the intent of this specification. Where applicable, equipment shall comply with ANSI standards for such equipment. All equipment shall be tested per IEEE testing standards listed in this section.

D. SPECIAL NOTE: The physical routing, length, and connections of the unit's phase, neutral and ground conductors are critical to the performance of surge suppression units. All wiring shall be installed by the manufacturer prior to shipping equipment and shall not exceed three feet of length.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: All surge suppression equipment shall be unconditionally warranted by the Contractor for a period of ten (10) years from the date of substantial completion. If longer manufacturer's warranties are offered, they shall be made available to the Owner. Note these extended warranties in the Operations and Maintenance Manuals.

B. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

- C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to, and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

- A. MANUFACTURERS: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Square D; a brand of Schneider Electric.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 4. Siemens.

2.2 GENERAL SPD REQUIREMENTS

- A. Provide UL listed and labeled lightning and transient surge protection devices (SPD's), installed where shown on the drawings and in accord with the manufacturer's recommendations. The surge protection devices shall be shunt type and poly-phase, with the ability to conduct high energy transients from line to neutral and neutral to ground.
- B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchgear short-circuit rating.
- C. SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
- D. Internal Device Overcurrent Protection (Fusing): All protection modes (including Neutral to Ground) of each surge suppression device shall be internally fused at the component level with fuse I²T capability allowing the suppressor's maximum rated transient current to pass through the suppressor without fuse operation. If the rated I²T characteristic of the fusing is exceeded, the fusing shall be capable of opening in less than one millisecond and clear both high and low impedance fault conditions. The fusing shall be capable of interrupting up to 200kA symmetrical fault current with 600 VAC applied. This overcurrent protection circuit shall be monitored, to provide indication of suppression failure. Conductor level fuses or circuit breakers internal or external to the surge suppression units are not acceptable as meeting this requirement.
- E. SPD shall be UL labeled as Type 1 or Type 2, intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls.
- F. Each MOV shall be individually fuse-protected to avoid cascading faults. This shall be certified by Manufacturers letter of compliance.
- G. SPD shall be UL labeled with 20kA nominal (I-n) (verifiable at UL.com) for compliance with UL 96A Lightning Protection Master Label and NFPA 780.
- H. SPD shall provide surge current paths for all modes of protection: L-N, L-G, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
- I. UL 1449, 3rd Edition Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

| System Voltage | L-N | L-G | L-L | N-G |
|----------------|-------|-------|-------|-------|
| 208Y/120 | 700V | 700V | 1200V | 700V |
| 480Y/277 | 1200V | 1200V | 1800V | 1200V |

Note : Numerically lower values are allowed/preferred; out-dated Suppressed Voltage Ratings (SVRs) shall not be submitted.

J. UL 1449, 3rd Edition Listed Maximum Continuous Operating Voltage (MCOV):

| System Voltage | Allowable System Voltage Fluctuation (%) | MCOV |
|----------------|--|------|
| 208Y/120 | 25% | 150V |
| 480Y/277 | 15% | 320V |

- K. SPD shall be installed integral to switchboards, panels, etc. where possible. SPD's shall be installed in new equipment at the factory and complete, furnished assemblies shall be UL listed.
- L. For each SPD, provide unit function status indicators. These indicators shall be mounted in the face of the equipment panel. Provide minimum one green LED per phase illuminated for normal operation, red L.E.D. for trouble/fault or reduction of surge suppression capacity.
- M. Proposed substitutions for the manufacturer's model numbers listed here shall meet or exceed the current published performance data for the units listed, and shall be submitted to the Engineer ten working days prior to bid for review.
- N. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SWITCHBOARD SURGE PROTECTION DEVICES

- A. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchgear short-circuit rating, and with the following features and accessories:
 1. Integral fused disconnecting means for each surge protection device.
 2. Fabrication using bolted compression lugs for internal wiring.
 3. Integral disconnect shall be able to withstand the single surge rating of the SPD.
 4. Redundant suppression circuits.
 5. Redundant replaceable modules.
 6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 7. LED indicator lights for power and protection status.
 8. Audible alarm, with silencing switch, to indicate when protection has failed.
 9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 10. Six-digit, transient-event counter set to totalize transient surges.
 11. Provide with self-diagnostic test function.
 12. SPD shall be UL labeled as Type 1 or Type 2.
- B. Peak Single-Impulse Surge Current Rating: 240 kA per mode/480 kA per phase.
- C. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- D. All units shall be 3-phase, 4-wire and shall have the following surge current capability (single pulse rated): Line to Neutral 480,000 amperes; Line to Ground 480,000 amperes; Line to Line 480,000 amperes; and Neutral to Ground 480,000 amperes. All MOV's shall be individually fused. The unit shall have a NEMA designed and certified safety interlocked integral disconnect switch with an externally mounted manual operator.
- E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277-V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 800V for 480Y/277.
 2. Line to Ground: 800V for 480Y/277.
 3. Neutral to Ground: 800V for 480Y/277.
- F. Protection modes and UL 1449 SVR for grounded wye circuits with 208Y/120-V, three-phase, four-wire circuits shall be as follows:
1. Line to Neutral: 400V for 208Y/120.
 2. Line to Ground: 400V for 208Y/120.
 3. Neutral to Ground: 400V for 208Y/120.

2.4 PANELBOARD AND DISTRIBUTION PANELBOARD SURGE SUPPRESSORS

- A. Branch and distribution panelboard units shall be installed as indicated on the contract documents and shall be 240kA per phase, heavy duty type. All units shall be 3 phase, 4 wire and shall have the following surge current capability (single pulse rated): Line to Neutral 240,000 amperes; Line to Ground 240,000 amperes; Line to Line 240,000 amperes; and Neutral to Ground 240,000 amperes. All MOV's shall be individually fused.
- B. Provide 60A circuit breaker in panel being protected for unit disconnecting means. Utilize #6 AWG wire for connection to panelboard. Maximum wire length is three feet.
- C. SPDs: Comply with UL 1449, Type 2.
1. Include LED indicator lights for power and protection status.
 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Comply with UL 1283.
- F. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
1. Line to Neutral: 1200 V for 480Y/277 V or 700 V for 208Y/120 V
 2. Line to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V
 3. Neutral to Ground: 1200 V for 480Y/277 V or 700 V for 208Y/120 V
 4. Line to Line: 2000 V for 480Y/277 V or 1200 V for 208Y/120 V
- G. SCCR: Equal or exceed 100 kA.
- H. Incominal Rating: 10 kA.

2.5 TELEPHONE AND TELEVISION SURGE SUPPRESSION

- A. As a part of this section of work, the Contractor shall provide U.L. listed lightning and surge arrestors on the incoming telephone, video, and television service lines.
- B. Arrestors shall be U.L. listed, properly grounded per N.E.C., and shall be located at the service entrance points for each cable. Also provide surge arrestors of the proper type for copper cables that are installed between buildings by the Contractor.
- C. Arrestors for telephone lines shall be RJ-45 in/out, complete with RJ-45 jumpers as needed. Provide quantity as required, connecting one to each phone line. Provide two spare units to Owner for future use.
- D. Arrestors for coaxial lines shall be 25 to 250 MHZ on cable T.V. lines (with BNC jacks in/out or as required by antenna connectors).

- E. Provide a ground lug for individual surge suppression unit installations, with the recommended ground wire size routed back to the building main electrical ground.
- F. Where multiple surge suppression units are installed, as at service entrance locations, provide a ground bar, copper with multiple tapped holes and a properly sized ground lead routed back to the building main electrical ground.

2.6 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs as indicated and in accordance with equipment manufacturer's written instructions, in compliance with applicable requirements of NFPA, local prevailing codes and with UL lightning and power surge protection standards to ensure that surge suppression systems comply with requirements.
- D. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- E. Use crimped connectors and splices only. Wire nuts are unacceptable.
- F. Wiring: Power Wiring: Comply with wiring methods in Section 260519.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

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MECHANICAL MODERNIZATION PROJECT
LWC COMMISSION NO. 20104.02

END OF SECTION

DIVISION 26 – ELECTRICALSECTION 265000 - LIGHTINGPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General, Special and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor is directed to examine each and every section of these specifications, all drawings relating to the Contract Documents, any and all Addenda, etc., for work described elsewhere that may relate to the provision of the work described herein. Materials and performance requirements are specified elsewhere herein that relate to these systems.
- C. Each Electrical Contractor's attention is directed to Section 260501 - General Provisions, Electrical, and all other Contract Documents as they apply to his work.

1.2 SUMMARY

- A. Section Includes Interior and Exterior Luminaires, Supports and Accessories

1.3 DESCRIPTION OF WORK

- A. This work consists of providing all labor, materials, accessories, mounting hardware and equipment necessary for an operationally and aesthetically complete installation of all luminaires, including power wiring, control wiring and accessories, in accordance with the contract documents.
- B. Contractor shall coordinate with Vendors and other trades, in advance of installation work, to define all infrastructure and installation requirements. Contractor shall coordinate all infrastructure requirements with all approved lighting equipment prior to infrastructure installation. This includes, but not limited to, appropriately sized, positioned, and located junction boxes, structural supports, feeds, power conduits and control conduits, and remote code-compliant power-supply enclosures.
- C. Contractor shall provide all luminaires, as herein specified, complete with lamps, drivers, power supplies, ballasts and accessories for safe and effective operation. All fixtures shall be installed and left in an operable condition with no broken, damaged or soiled parts.
- D. Contractor shall coordinate all infrastructure requirements with all approved lighting equipment prior to infrastructure installation, including, but not limited to appropriately sized, positioned and located junction boxes, structural supports, feeds, power and control conduits, and remote code-compliant power-supply enclosures.
- E. All luminaires, items, equipment and parts furnished and specified herein shall bear the "UL Approved" label (or other NRTL label) to indicate compliance with UL requirements. All luminaires shall be manufactured in strict accordance with the appropriate and current requirements of the National Electrical Code as verified by Underwriters Laboratories, Inc. (UL), or tested to UL standards by other nationally recognized testing laboratory (NRTL) as acceptable to Building Officials and Code Administrators International (BOCAI); the International Conference of Building Officials (ICBO); or other relevant code authority recognized by the local jurisdiction within which the project is being constructed. Such a listing shall be provided for each luminaire type, and the appropriate label or labels shall be affixed to each luminaire in a location as required by code or law. All luminaires shall be UL/NRTL listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations, as required.
- F. All available finishes and colors, for each luminaire, shall be submitted to the Architect for selection during shop drawing review. Premium finishes, where indicated, shall be provided at no additional cost premium.

- G. Specifications and drawings are intended to convey all salient features, functions and characteristics of the luminaires only, and do not undertake to illustrate or set forth every item or detail necessary for the work. Minor details, not usually indicated on the drawings nor specified, but that are necessary for proper execution and completion of the luminaries, shall be included, the same as if they were herein specified or indicated on the drawings.
 - H. The Owner, Architect and Engineer shall not be held responsible for the omission or absence of any detail, construction feature, etc. which may be required in the production of the light fixtures. The responsibility of accurately fabricating the light fixtures to the fulfillment of the specification rests with the Contractor.
 - I. Refer to architectural details as applicable for recessed soffit fixtures or wherever fixture installations depend upon work of other trades. Coordinate all installations with other trades. Verify dimensions of spaces for fixtures, and if necessary, adjust lengths to assure proper fit and illumination of diffuser and/or area below.
 - J. In accordance with the above and the criteria established herein, the Contractor is responsible for assuring the final design, fabrication and installation which fulfills the requirements of the Contract Documents.
- 1.4 CODES: Materials and installations shall be in accordance with the latest revision of the National Electrical Code and any applicable Federal, State and local codes and regulations.
- 1.5 REFERENCE STANDARDS: The publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. The publications may be referred to in the text by the basic designation only.
- A. American National Standards Institute (ANSI)
 - B. American Society for Testing and Materials (ASTM)
 - C. Certified Ballast Manufacturers Association (CBM): Requirements for Ballast Certification.
 - D. Federal Communications Commission (FCC)
 - E. Entertainment Services and Technology Association: ESTA E1.3 - Entertainment Technology - Lighting Control System - 0 to 10V Analog Control Protocol
 - F. International Electrotechnical Commission (IEC)
 - G. Illuminating Engineering Society of North America (IESNA)
 - H. Institute of Electrical and Electronic Engineers (IEEE): C62.41-91 - Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits
 - I. National Fire Protection Association (NFPA):
 - 1. NFPA 70 - National Electrical Code (NEC), National Fire Protection Association
 - 2. NFPA 101 - Life Safety Code, National Fire Protection Association
 - J. National Electrical Manufacturer's Association (NEMA)
 - K. OSHA 29CFR1910.7 – Luminaires shall be listed by National Recognized Testing Laboratory Approved by United States Department of Labor.
 - L. Underwriters Laboratories, Inc. (UL)
- 1.6 ACRONYMS AND DEFINITIONS
- A. Light Fixture (Luminaire): Complete lighting unit consisting of a lamp(s) and driver(s)/ballast(s) (when applicable) together with the parts designed to distribute the light, to position and protect the lamp(s), and to connect the lamps to the power supply.
 - B. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.7 EQUAL MANUFACTURERS

- A. Manufacturers listed as “Equal” to the Basis of Design on the light fixture schedule shall submit product cutsheets to the Engineer ten (10) days prior to bid for final written approval. This written approval will only be issued in addendum form. “Equal” fixtures shall be of equal or better quality and performance to the fixture(s) listed with manufacturer’s model numbers. Burden of proof shall be on the Contractor, Vendor and manufacturer.
- B. Upon request by Engineer, the Contractor shall submit manufacturer’s computerized horizontal illumination levels using AGI32 software in footcandles at workplane (30" above finished floor), taken every 3 feet in every interior room and area. Include average maintained footcandle levels and maximum and minimum ratio.
- C. Upon request by Engineer, the Contractor shall submit manufacturer’s computerized horizontal illumination levels using AGI32 software in footcandles, taken every ten (10) feet at grade for the entire exterior site. Include average maintained footcandle levels and maximum and minimum ratio.

1.8 SUBMITTALS

- A. Submittal data shall be in accordance with Division 01 SUBMITTAL Specification Section, IECC and as specified herein.
- B. Light fixture factory shop drawings and cuts, showing fixture dimensions, photometric data and installation data shall be submitted to the Engineer for review 15 days after project award date.
- C. Product Data: For each type and model of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. All available finishes and colors for each luminaire type shall be submitted to the Architect for selection during review.
 - 4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for light fixtures.
 - 5. Dimensions, effective projected area (EPA), accessories, installation details and construction details.
 - 6. Poles: Include dimensions, wind load determined in accordance with AASHTO, pole deflection, pole class, and other applicable information.
 - 7. Distribution data according to IESNA classification type as defined in IESNA HB-10.
 - 8. Amount of shielding on luminaires.
 - 9. Control type: 0-10V, DMX, bi-level, etc.
 - 10. Warranty.
- D. Shop Drawings: Including plans, elevations, sections, details, and attachment to other work.
 - 1. Include detailed equipment assemblies and indicate electrical ratings, dimensions, emergency section, control type, wiring, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
- E. Pole and Support Component Certification Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

1.9 QUALITY ASSURANCE

- A. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 and NEMA unless more stringent requirements are specified or indicated.

- B. Where groups of luminaire types exhibit the same list of acceptable Manufacturers, such as downlights, accents, and wall washers, the intent is to have a final installation with the same Manufacturer's equipment across the groupings as specified for consistency of optics, aesthetics, and similarity of maintenance procedures. Mixing/matching across groups is unacceptable. This also applies to multi-phased projects with single or multiple, but related luminaire types exhibiting the same list of acceptable Manufacturers, except where products have subsequently been discontinued or significantly redesigned in size, appearance, lamping, or gear. Lamps shall be from a single manufacturer and batch.
 - C. Product procurement and coordination: Contractor shall:
 - 1. Order products according to application.
 - 2. Confirm the proper and complete catalog number with distributor and agent.
 - 3. Ensure wiring, driver, etc meets the specifications and proper requirements.
 - 4. Provide additional parts and pieces required to complete the installation in the location and manner intended by the design.
- 1.10 COORDINATION
- A. Coordinate layout and installation of exterior lighting fixtures with all other construction including all underground utilities and geothermal well fields.
 - B. Coordinate layout and installation of lighting fixtures with all other construction that penetrates ceilings or is supported by them, including HVAC equipment, plumbing, fire-suppression system and partition assemblies. Refer to Architects reflected ceiling plan (RCP) for locations of all ceiling devices.
- 1.11 PRODUCT DELIVERY, STORAGE AND HANDLING:
- 1.12 The Contractor shall provide, receive, unload, uncrate, store, protect and install lamps, luminaires and auxiliary equipment, as specified herein, in accordance with respective manufacturers' project conditions of temperature and humidity and with appropriate protection against dust and dirt. Lamps for miscellaneous equipment shall be provided and installed by the Contractor according to equipment manufacturers' guidelines. All products shall be stored in manufacturer's unopened packaging until ready for installation.
- A. Luminaire Poles: Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Support poles to prevent distortion and arrange to provide free air circulation. Retain factory-applied pole wrappings on poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.
- 1.13 EXTRA MATERIALS
- A. Furnish the following extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing content:
 - 1. Single Sided Exit Sign: One (1) for every fifteen (15) of each type. Furnish at least two (2) of each type.
 - 2. Double Sided Exit Sign: One (1) for every fifteen (15) of each type. Furnish at least one (1) of each type.
 - 3. LED Drivers: One (1) for every fifty (50) of each type and rating installed. Furnish at least five (5) of each type.
 - 4. LED Lamps/Boards: One (1) for every one-hundred (100) of each type and rating installed. Furnish at least two (2) of each type.
- 1.14 WARRANTIES
- A. The equipment items shall be supported by service organizations which are reasonably convenient (less than 100 miles from project site) to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
 - B. All luminaries, finishes, poles and all of its component parts, workmanship, and controls shall have an unconditional ten (10) year on-site replacement warranty. Warranty shall include all light fixtures, lamps,

drivers, poles, finishes and all components to be free from defects in materials and workmanship for a period of ten (10) years from date of Owner's acceptance. On-site replacement includes transportation, removal, and installation of new products. Replacement of luminaires, faulty materials and the cost of labor to make the replacement shall be the responsibility of the Contractor.

- C. The Warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to and run concurrently with other warranties made by the Contractor under requirements of the Contract Documents.
- D. LED drivers: The warranty period shall not be less than ten (10) years from the date of substantial completion. The warranty shall state the malfunctioning LED driver shall be exchanged by the manufacturer and promptly shipped to the Owner. The replacement LED driver shall be identical to, or an improvement upon, the original design of the malfunctioning LED driver.

PART 2 - PRODUCTS:

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide one of the products indicated on Light Fixture Schedule. Refer to Light Fixture Schedule for manufacturers and model numbers. Basis of Design for each light fixture type shall be the first fixture manufacturer and model number for each type listed. Refer to Specification Section 260501, paragraph EQUAL MANUFACTURERS for additional requirements.
- B. Manufacturer's catalog numbers together with the descriptions on the drawings and these specifications are indicative of required design, appearance, quality and performance. Report any discrepancies between any of these to the Engineer for resolution prior to bid. In absence of such notice to the Engineer, provide the greater requirement as directed by the Engineer, without additional cost.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS: Comply with the requirements specified in the Articles below and the Light Fixture Schedule.

- A. Complete luminaires shall be in accordance with NFPA 70, NEMA, and UL 1598 listed and labeled.
- B. Ballasts, drivers, or transformers, unless otherwise specified, shall be field replaceable and shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.
- C. Luminaires shall be entirely factory wired by the luminaire manufacturer in accordance with code and UL requirements and shall be furnished fully compatible with the project electrical wiring and controls system for smooth, continuous, dimming or on/off flicker-free operation.
- D. Exterior building mounted light fixtures shall be UL classified for damp or wet locations as applicable and shall be complete with gaskets, cast aluminum outlet box and grounding. All dissimilar metal materials shall be separated by non-conductive materials to prevent galvanic action.
- E. All luminaires supplied for recessing in suspended ceilings shall be supplied with pre-wired junction boxes, unless otherwise specified.
- F. Metal parts: Free of burrs, sharp corners and sharp edges.
- G. Doors, frames and other internal access: Smooth operating, free of light leakage under operating conditions. Designed to prevent doors, frames, lenses, diffusers and other components from falling accidentally during maintenance and when secured during operating position.
- H. Mounting Frames and Rings: If ceiling system and luminaire type requires, each recessed and semi-recessed luminaire shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed as coordinated by Contractor. The frames and rings shall be one piece and of sufficient size and strength to sustain the weight of the luminaire and maintain plumb. Luminaires shall be braced such that the force required to close and/or latch lens or door frame does not lift or shift luminaire.

- I. Pendant Supports: Contractor shall be responsible for coordination with Manufacturer, Architect, Structural Engineer and related trades to ensure that proper and adequate structural reinforcement is provided within ceilings to support pendant mounted lighting equipment for a secure, neat, square, plumb appearance. Pendants shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- J. Wall Bracket (Sconce) Supports: Contractor shall be responsible for coordination with Manufacturer, Architect, Structural Engineer and related trades to ensure that proper and adequate structural reinforcement is provided within walls to support wall mounted lighting equipment for a secure, neat, square, plumb appearance. Wall brackets shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- K. All lenses or other light diffusing elements shall be removable for access to lamp and electrical and electronic components and luminaire cleaning, however, they must otherwise be positively and securely held in-place, unless otherwise specified.
- L. All lens door or holder trim flanges shall fit plumb and flush with the ceiling or wall surface. There shall be no light leaks around the interface between lens door or holder trim flanges and the ceiling or wall.
- M. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility.
- N. Recessed luminaires mounted in an insulated ceiling shall be listed for use in insulated ceilings, IC-rated or provisions made to maintain code-compliant 3" air-space around luminaires in accordance with Manufacturers' instructions.
- O. Mechanical Safety: Unless otherwise specified, luminaire closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- P. Unless otherwise specified, luminaires with louvers or light transmitting panels shall have hinges, latches and safety catches to facilitate safe, convenient cleaning and re-lamping. Vapor tight luminaires shall have stainless steel pressure clamping devices.
- Q. Yokes, brackets and supplementary supporting members necessary for mounting lighting equipment shall be furnished and installed by the Contractor and approved by the Architect. All materials, accessories, and any other equipment necessary for the complete and proper installation of luminaires, lamps, ballasts/neon transformers included in the contract shall be furnished and installed by the Contractor. All yokes, brackets and supplementary supports shall provide a neat, square, plumb and level appearance, and shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with all lamps, globes, lenses, lens frames or doors etc. in place.
- R. All connections shall be fixed rigid by screws, rivets and/or soldering. Screws and rivets shall not be visible except as necessary for maintenance and/or aesthetic appearance. All connections shall provide a neat, square, plumb and level appearance, and shall not sag, droop, snake or otherwise appear out of plumb or alignment in finished installation with lamps, globes, lenses, lens frames or doors etc. in place.
- S. All sheet metal work shall be free from tool marks and dents and shall have accurate angles bent as sharp as compatible with the gauges of the required metal and the luminaire styling. All intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly.
- T. For steel and aluminum luminaires, all screws, bolts, nuts and other fastening and latching hardware shall be a cadmium or equivalent plated. For stainless steel luminaires, all hardware shall be stainless steel. For all bronze luminaires, all hardware shall be bronze.
- U. Extruded aluminum frames and trims shall be rigid and manufactured from quality aluminum without blemishes in the installed product. Miter cuts shall be accurate; joints shall be flush and without burrs and cut alignment maintained with the luminaire located in its final position.

- V. Castings shall exactly replicate the approved pattern(s) and shall be free of sand pits, blemishes, scales and rust and shall be smoothly finished, excepted as necessary for an authentic historic appearance and as agreed by Architect. Tolerances shall be provided for any shrinkage in order that the finished castings accurately fit their locations resulting in plumb and level fit and consistently tight-seamed fittings.
 - W. Outdoor Luminaires: Luminaires shall be suitably gasketed and vented according to manufacturer's instructions. All dissimilar metal materials shall be separated by non-conductive materials to prevent galvanic action.
 - X. Luminaires in Hazardous Areas: Luminaires shall be suitable for installation in flammable atmospheres (Class and Group) as defined in NFPA 70 and shall comply with UL 844.
 - Y. Each light fixture shall be packaged with complete instructions and illustrations on how to install.
 - Z. Each light fixture box, container, etc shall be labeled at the factory with the type designation as indicated on the Light Fixture Schedule.
 - AA. Fixture whips shall be 1/2" flexible, with clamp-on steel fittings at each end, six-foot maximum length, with insulated throat bushings at each end and bonding locknuts. Wiring thru fixture whips shall be #12 AWG, with #12 AWG ground bonded to outlet at source end.
 - BB. All luminaires that are split-wired shall be provided with a permanently affixed lamacoid warning label on the ballast channel cover indicating two hot circuits present and indicating both normal and emergency power panel and circuit numbers.
 - CC. Provide custom, factory cut stem lengths as required.
 - DD. Contractor shall verify ceiling types prior to ordering fixtures and provide fixtures appropriate to the actual condition. This is to include specific type of lay-in ceiling grid.
 - EE. Exit signs and fixtures that are hatched or where the fixture type contains the suffix "E" for emergency operation, the fixture shall have an integral 90-minute battery inverter if not powered from an emergency generator.
 - FF. All battery powered fixtures shall have test switches factory installed integral to the reflector. Remote test switches will not be accepted.
- 2.3 LUMINAIRE REFLECTORS AND TRIMS
- A. Alzak cones, reflectors, baffles and louvers shall be warranted against discoloration.
 - B. All trims, reflectors and canopies shall fit snugly and securely to the ceiling or wall so that no light leak occurs.
 - C. Trims shall be self-flanged, unless otherwise specified.
 - D. For trimless or flangeless luminaires, Contractor shall coordinate with other Trades to achieve a trimless/flangeless installation acceptable to the Architect. Where ceilings are drywall or plaster, this involves Level 5 finishes or as otherwise directed by the Architect. In drywall, plaster, wood, or stone ceilings, special luminaire collars and exacting coordination are required of Contractor.
- 2.4 LIGHT EMITTING DIODE (LED) ELECTRONIC DRIVERS: The electronic driver shall at a minimum meet the following characteristics:
- A. LED drivers shall comply with NEMA SSL 1, NFPA 70, and UL 8750 unless otherwise specified.
 - B. Drivers remote from luminaires shall be housed in NEMA enclosures so rated for the driver and located in code-compliant, sound-isolated, well-ventilated and easily accessible areas. Wire shall be sized according to run length and LED Manufacturer's size and distance-of-run requirements and all in accordance with all code requirements.

- C. Driver shall comply with UL 1310 Class 2 requirements for dry and damp locations, NFPA 70 unless specified otherwise. Drivers shall be designed for the wattage of the LEDs used in the indicated application. Drivers shall be designed to operate on the voltage system to which they are connected.
 - D. LED driver shall withstand up to a 1,000-volt surge without impairment of performance as defined by ANSI C62.41 Category A.
 - E. LED driver shall tolerate ± 10 percent supply voltage fluctuation with no adverse effects to driver or LEDs.
 - F. Drivers for luminaires controlled by dimming devices shall be as specified herein and equipped for dimming and conform to the recommendations of the manufacturer of the associated dimming devices to assure satisfactory operation of the lighting system. Contractor shall coordinate all wiring infrastructure to accommodate final-selected drivers and controls systems for smooth, continuous, and flicker-free operation.
 - G. Flicker: The flicker shall be less than 5 percent at all frequencies below 1000 Hz and without visible flicker.
 - 1. Drivers shall meet or exceed NEMA 410 driver inrush standard.
- 2.5 LIGHT EMITTING DIODE (LED): The light emitting diodes shall as a minimum meet the following characteristic:
- A. LED lamps shall comply with ANSI C78.1.
 - B. Light emitting diodes shall be tested under IES LM-80 standards.
 - C. Color Rendering Index (CRI) shall be 84 (minimum).
- 2.6 SUSPENDED LUMINAIRES
- A. Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation. Hangers shall be cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Hangers shall allow fixtures to swing within an angle of 45 degrees. Brace pendants 4 feet or longer to limit swinging. Single-unit suspended fixtures shall have twin-stem hangers. Multiple-unit or continuous row fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 0.18 inch diameter.
 - B. All suspended luminaires with a weight in excess of 150 pounds shall be fitted with safety cable of sufficient strength and length to meet all UL safety cable load-bearing requirements. Cable shall exhibit a finish (but not painted) compatible with that of the metal finish of the stem/chain/suspension-cable assembly or alternatively finished in black as approved by Architect. Shop drawings shall indicate luminaire weight. Contractor shall coordinate structural support/attachment requirements including independent structure for safety cable attachment with Vendor, Architect, and Structural Engineer and all respective trades. Safety cable shall exhibit sufficient length to wrap tightly and entirely around structural member at least twice before attachment subject to Vendor confirmation of UL requirements and pending Structural Engineer review. Contractor shall provide labor necessary for the stem/chain-assembly-wiring-threading and safety-cable-attachment as instructed by Vendor.
- 2.7 DOWNLIGHT FIXTURES AND COMPONENTS
- A. Downlights shall be listed for thru-branch circuit wiring, recessing in ceilings and damp locations. Where installed in plaster or drywall or other inaccessible ceiling types, they shall be UL listed for bottom access.
 - B. Provide with tool-less hinged junction box access cover and thermal protection.
 - C. Provide telescoping channel bar hangers that adjust vertically and horizontally.
- 2.8 EXIT SIGNS
- A. General requirements: UL 924, NFPA 70, AND NFPA 101.

- B. Provide single or double face as scheduled, indicated on plans or as required by the local Authority Having Jurisdiction. Adjust installation position if required for clear visibility, in accordance with applicable codes.
- C. Provide directional arrows (chevrons) as indicated on floor plans and to suit the means of egress or as required by the local Authority Having Jurisdiction.
- D. Where emergency backup battery packs are provided with exit lights, they shall have capacities for continuous operation per applicable codes.
- E. Complete unit to be furnished in color as selected by the Architect.

2.9 LUMINAIRE SUPPORT HANGERS AND COMPONENTS

- A. Wires: ASTM A641/A641M, Class 3, soft temper, galvanized regular coating, 0.1055 inches in diameter (12 gage).
- B. Straps: Galvanized steel, one by 3/16 inch, conforming to ASTM A653/A653M, with a light commercial zinc coating or ASTM A1008/A1008M with an electrodeposited zinc coating conforming to ASTM B633, Type RS.
- C. Rod Hangers: Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

2.10 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Provide poles designed for site specific wind loading (minimum of 120 miles per hour) determined in accordance with AASHTO LTS while supporting luminaires and all other appurtenances indicated. The effective projected areas of luminaires and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be anchor-base type designed for use with underground supply conductors. Poles shall have full base metal covers with matching finish.
- B. Structural Characteristics: Comply with AASHTO LTS
 - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
 - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.3 to obtain the equivalent projected area to be used in pole selection strength analysis.
- C. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners, unless otherwise indicated.
- D. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 - 1. Materials: Shall not cause galvanic action at contact points.
 - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
 - 3. Anchor-Bolt Template: Plywood or steel.
- E. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- F. Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Anchor bolts shall be steel rod having minimum yield strength of 50,000 psi and shall be galvanized in accordance with ASTM A153/A153M. Concrete shall be as specified in Division 03 Specification Section, CAST-IN-PLACE CONCRETE.
- G. Breakaway Supports: Provide frangible breakaway supports where noted on plans, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS.
- H. Brackets and Supports

1. ANSI C136.3, ANSI C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1-1/4 inch secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head. Detachable, cantilever, without underbrace.
 - I. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
 - J. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire.
 - K. Finish: Same as luminaire.
- 2.11 FUSING: All luminaires shall be provided with fuse(s) and in-line fuse holder(s). Fuse pole mounted luminaires at handhole.
- 2.12 POLE ACCESSORIES
 - A. Duplex Receptacle: Where indicated or plans, provide 120 V, 20 A in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for a weather resistant, ground-fault circuit-interrupter type. Recessed, 12 inches above finished grade. Weatherproof, in-use cover, color to match pole, that when mounted results in NEMA 250, Type 4X enclosure with cord opening and lockable hasp and latch that complies with OSHA lockout and tag-out requirements.
- 2.13 EQUIPMENT IDENTIFICATION
 - A. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.
 - B. Factory-Applied Labels: Provide labeled luminaires in accordance with UL 1598 requirements. All light fixtures shall be clearly marked for operation of specific LED's and drivers according to proper type. The following characteristics shall be noted in the format "Use Only _____":
 1. LED or lamp type, and nominal wattage
 2. Driver or ballast type
 3. Correlated color temperature (CCT) and color rendering index (CRI)
 4. All markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Drivers and ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.
- 2.14 FACTORY APPLIED FINISH: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Architect's reflected ceiling plan (RCP) shows actual locations of all light fixtures, diffusers and system devices. Report to the Architect/Engineer any conflicts. Do not scale plans for exact location of lighting fixtures.
- B. Install luminaires in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", and NEMA standards.

- C. Electrical installations shall conform to and meet IEEE C2, NFPA 70, and to the requirements specified herein.
- D. Installed luminaires shall be provided with protective covering by Contractor until such time as the space(s) is cleaned and ready for occupancy.
- E. Align, mount and level the luminaires uniformly. All luminaires shall be installed plumb/true and level as viewed from all directions. Luminaires shall remain plumb and true without continual adjustment.
- F. Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.
- G. Recessed, semi-recessed and surface fixtures shall be independently supported from the buildings structure. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Round fixtures or fixtures smaller in size than the ceiling grid shall be independently supported from the building structure by a minimum of four wires per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires for lighting fixture support in this section. Lighting fixtures installed in suspended ceilings shall also comply with the requirements of Division 09 Specification Sections GYPSUM BOARD, ACOUSTICAL PANEL CEILINGS and SUSPENDED DECORATIVE WOOD GRIDS. Support lay-in ceiling light fixtures as follows:
 - 1. Support fixtures with four (4) wires, with one (1) at each corner. Hanger wires shall be installed within 15 degrees of plumb or additional support shall be provided. Wires shall be attached to fixture body and to the building structure (not to the supports of other work or equipment).
 - 2. Where building structure is located such that 15 degrees cannot be maintained, the Contractor shall provide "Uni-strut" or similar structure to meet this requirement.
 - 3. Support Clips: All fixtures shall be furnished with hold down clips to meet applicable seismic codes. Provide four (4) clips per fixture minimum or the equivalent thereof in the installation trim. Fasten to light fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application. Contractor shall install clips per manufacturer's requirements. If screws are required, they shall be provided.
- H. Lighting Fixture Supports:
 - 1. Shall maintain the fixture positions after cleaning and re-lamping.
 - 2. For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system.
- I. Downlights, exit signs and battery pack supported by or attached to ceiling grid or tile shall be provided with one hanger wire at each end. Provide a minimum of two, located at opposite corners. Hanger wires shall be installed within 15° of plumb, maximum or additional support shall be provided. Wires shall be attached to the fixture body and to the building structure and not to the supports of other work or equipment.
- J. Luminaires installed and used for working light during construction shall be replaced prior to turnover to the Owner if more than 3 percent of their rated life has been used. Fixtures shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer.
- K. Suspended fixtures shall hang plumb and shall be located with no obstructions within the 45 degree range in all directions. The stem, cable, canopy and fixture shall be capable of 45 degree swing. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be

supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown.

- L. Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, a finishing ring painted to match the ceiling, shall be used to conceal the junction box.
- M. Rigidly align continuous rows of light fixtures for true in-line appearance.
- N. Exit Signs and Emergency Lighting Units: Wire exit signs ahead of the switch to the un-switched branch circuit located in the same room or area. Connect to emergency life safety branch circuit where applicable.
- O. Where emergency battery packs are provided with fixtures (if any), they shall be connected to an un-switched power line and wired in accordance with applicable codes and the manufacturer's recommendations.
- P. Light fixture whips shall be supported from the building structure. Do not clip to lay-in ceiling support wires.
- Q. Exterior Fixtures:
 - 1. Exterior building mounted light fixtures shall not be installed until after the building exterior has been rinsed clean of any corrosive cleaning materials. Damaged fixtures shall be replaced by the Contractor at no cost.
 - 2. Provide exterior rated weather proof junction boxes for all fixtures and splices.
 - 3. Utilize weatherproof silicone filled wire nuts and seal all junction boxes and conduit with potting compound to create waterproof barriers. Inspect all splices and fixtures for continuity prior to potting.
 - 4. Lubricate all threaded parts with a high temperature waterproof anti-seize lubricant to prevent seizing and corrosion.
 - 5. All low-voltage wiring to be UV resistant, UL approved for use without conduit, stranded low-voltage wire (Q-Wire by Q-Tran or equal) for use in outdoor and underground applications, gauge as appropriate to avoid voltage drop.
- R. Transformers (applies to all transformers including (but not limited to) low voltage, neon, remote ballast, LED power supplies, exterior locations):
 - 1. Electrical Contractor to locate all transformers (including low voltage, neon, remote ballasts, led power supplies, etc.) near fixtures in a well-ventilated and accessible location. Transformers must be installed (per codes) in accessible areas large enough to dissipate the heat of the transformer. Temperatures should not exceed 100°F (38°C) or that required by manufacturer if more stringent.
 - 2. Electrical Contractor to determine wire size according to load and wire length to eliminate voltage drop. If voltage drop is a problem after installation, the Electrical Contractor is responsible for reinstallation (at no additional cost) of transformer and wire to solve problem.
 - 3. Electrical Contractor to label front of transformer/driver. Example: "Large Display Case @ Entry to Main Dining Room."
- S. Light fixture locations in mechanical and electrical equipment rooms/areas are approximate. Locate light fixtures to avoid equipment, ductwork, and piping. Locate around and between equipment to maximize the available light. Coordinate mounting heights and locations of light fixtures to clear equipment. Request a meeting with the Engineer if uncertain about an installation.
- T. Contractor shall be responsible for sealing all luminaires for wet and damp locations (i.e. all knock-outs, all pipe and wire entrances, etc.) to prevent water wicking.
- U. Coordinate between the electrical and ceiling trades to ascertain that approved luminaires are furnished in the proper sizes, with the proper flange details, and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.

- V. All reflecting surfaces, glass or plastic lenses, ballast housings, parabolic louvers, downlighting alzak cones and specular reflectors and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
- W. Handle all reflecting surfaces, glass or plastic lenses, ballast housings, parabolic louvers, downlighting alzak cones and specular reflectors and other decorative elements with care during installation or lamping to avoid fingerprints or dirt deposits.

3.2 POLE, LIGHT COLUMN AND BOLLARD INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: 60 inches
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet
 - 3. Trees: 15 feet from tree trunk.
- C. Excavation: Restrict excavation in size to that which will provide sufficient working space for installation of concrete forms. Should soil conditions at the bottom of the excavation be unsuitable as a foundation, as determined by the Architect, take the excavation down to firm soil and fill to required grade with concrete or satisfactory soil materials as directed.
- D. Formwork: Construct forms of wood, plywood, steel, or other acceptable materials fabricated to conform to the configuration, line, and grade required. Reinforce formwork to prevent deformation while concrete is being placed and consolidated. Wet or coat formwork with a parting agent before placing concrete.
- E. Backfill: Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell.
- F. Foundation-Mounted Poles:
 - 1. Install according to pole manufacturer's instructions using a template supplied by pole manufacturer in accordance with the lighting standard manufacturer's recommendations.
 - 2. Use galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end, and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 3. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
 - 4. Mount pole with leveling nuts and tighten top nuts to torque level recommended by pole manufacturer. Provide base covers.
- G. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 - 1. Dig holes large enough to permit use of tampers in the full depth of hole.
 - 2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
- H. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 - 1. Make holes 6 inches in diameter larger than pole diameter.
 - 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
 - 3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
 - 4. Cure concrete a minimum of 72 hours before performing work on pole.

- I. Poles and Pole Foundations Set in Concrete Paved Areas (Slabs): Install poles with minimum of 6-inch wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.
- J. Raise and set poles using web fabric slings (not chain or cable). Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. Alterations to poles after fabrication will void manufacturer's warranty and shall not be allowed.
- K. Bollards and Light Columns: Cast conduit into base, and shape base to match shape and diameter of bollard and/or light column base. Finish by troweling and rubbing smooth.

3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth.

3.4 GROUNDING

- A. Bond luminaires and metal accessories to the grounding system per National Electrical Code.
- B. Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.
- C. At each pole and light bollard, provide a driven ground rod into the earth so that after the installation is complete, the top of the ground rod will be approximately 1 foot below finished grade. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.5 IDENTIFICATION

- A. Light fixtures served from multiple power sources, such as emergency fixtures fed from emergency transfer relay, shall have the following label affixed to it: "DANGER - ELECTRICAL SHOCK HAZARD - LIGHT FIXTURE HAS MULTIPLE POWER SOURCES"

3.6 CLEANING

- A. At completion of each phase and the time of final acceptance by the Owner, all lighting fixtures shall have been thoroughly cleaned with materials and methods recommended by the manufacturer.
- B. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens/louvers prior to final acceptance. Cleaned with solvent recommended by the manufacturer to a like-new condition or replaced. All reflectors shall be free of paint other than factory-applied, if any.

3.7 TESTING AND ADJUSTMENT

- A. The lighting and lighting controls systems shall be synchronized and fully operable to address the lighting operation in a complete and code-compliant manner.
- B. All adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Architect and Engineer. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor. All aiming and adjusting shall be performed after the entire installation is complete for each phase or area. The Contractor shall be responsible for notifying the Architect of appropriate time for final luminaire adjustment. Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night at no premium cost.
- C. All ladders, scaffolds, lifts, gloves, cleaning cloths, access/adjustment tools, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- D. Replace defective lamps, ballasts and drivers.

3.8 FIELD QUALITY CONTROL:

- A. Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal and emergency power sources.
- C. Dimming Drivers. Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range.
- D. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- E. Inspect each light fixture for damage. Replace damaged light fixtures at no cost to the Owner.
- F. Fixtures showing dirt, dust or fingerprints shall be restored to like new condition or shall be replaced at no cost.

END OF SECTION 265000

31
DIVISION

EARTHWORK

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Temporary erosion and sedimentation control measures.

B. Related Sections:

1. Division 01 Section "Construction Facilities and Temporary Controls".
2. Division 01 Section "Cutting and Patching".
3. Division 01 Section "Construction Waste Management and Disposal".

1.2 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- C. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS

- A. Existing Conditions: Documentation of adjoining construction and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
1. Use sufficiently detailed photographs or video.

- B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.5 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternative routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.
- C. Utility Locator Service: Notify Indiana Utility Protection Services for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.
- E. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Erection of sheds or structures.
 - 4. Impoundment of water.
 - 5. Excavation or other digging unless otherwise indicated.
 - 6. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- G. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 Materials

- A. Satisfactory Soil Material: Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install sedimentation and erosion control measures before commencing site clearing.

- B. Protect and maintain benchmarks and survey control points from disturbance during construction.
- C. Locate and clearly identify trees, shrubs, or other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches above the ground.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction and as indicated.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining on-site.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than three days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods for grubbing within tree protection zone.
 - 4. Chip removed tree branches and stockpile in areas approved by Owner.

- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (4 inches in confined areas), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depths as needed for construction in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste material.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within tree protection zones.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for walks, pavements, turf and grasses, and plants.
2. Subgrades and base course for walks and pavements.
3. Subgrades and base course for asphalt paving.
4. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls".
2. Division 31 Section "Site Clearing".
3. Division 31 Section "Dewatering".
4. Division 32 Section "Turf and Grasses".

1.2 DEFINITIONS

A. Backfill: Soil material or engineered material used to fill an excavation.

1. Initial Backfill: Backfill placed 12 inches over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subgrade course and walks and pavements.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer that minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 1 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/inch when tested by an independent geotechnical testing agency, according to ASTM D 1586.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subgrade: Uppermost surface of an excavation or top surface of a fill or backfill immediately below base, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Geotextile.
 - 2. Controlled low-strength material, including design mixture.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Warning Tape: 12 inches long; of each color.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487
 - 2. Grading report for each granular material.

1.4 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify Indiana Utility Protection Services for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures are in place.
- D. Do not commence earth moving operations until plant-protection measures are in place.
- E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Erection of sheds or structures.
 4. Impoundment of water.
 5. Excavation or other digging unless otherwise indicated.
 6. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; conforming to ODOT Item 304.
- E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; conforming to ODOT Item 310.
- F. Drainage Course: Narrowly graded mixture of washed stone, or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 56 or 57.
- G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- H. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- I. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with ODOT 712.9 Type A.

- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with ODOT 712.9 Type A.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, flowable concrete material conforming to ODOT Item 613.

2.4 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install sedimentation and erosion control measures before commencing site grading.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- D. Excavations and Embankments shall conform to the requirements of ODOT Item 203.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding any portion of Project site and surrounding area at all times.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 - 1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide 12 inches minimum clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.

- C. Trench Bottoms: Excavate and shape trench bottom to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. For pipes and conduit 4 inches or larger in nominal diameter, provide flat bottomed trench to allow for bedding material to be placed.
 - 2. For flat-bottomed, multiple-duct conduit units, excavate trench bottoms and support conduit on an undisturbed subgrade.
 - 3. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

- D. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots than interfere with installation or utilities.
 - 3. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements per ODOT Item 204 to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Low Strength Mortar may be used when approved by Architect.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Backfill trenches excavated under footings with concrete and as indicated.
- C. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- D. Place and compact initial backfill free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill or satisfactory soil material.
4. Under building slabs, use engineered fill or satisfactory soil material.
5. Under footings and foundations, use engineered fill or satisfactory soil material.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials, including trench backfill, to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill soil material at 100 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 4. Place subbase and base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place subbase and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 100 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 24 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course where indicated under cast-in-place concrete slabs-on-grade as follows:
 - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 - 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at locations and frequencies at the discretion of the Owner.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property unless otherwise indicated.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes construction dewatering.

1.2 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
 - 1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 5. Remove dewatering system when no longer required for construction.

1.3 SUBMITTALS

- A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
 - 1. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.
- B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Photographs: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
 - 2. The geotechnical report is included elsewhere in the Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Monitor dewatering systems continuously.
- E. Promptly repair damages to adjacent facilities caused by dewatering.
- F. Protect and maintain temporary erosion and sedimentation controls.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
- E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
 - 1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 FIELD QUALITY CONTROL

- A. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 312319

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DIVISION

EXTERIOR IMPROVEMENTS

SECTION 323119 – ORNAMENTAL PRIVACY FENCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Ornament privacy fences.
- 2. Swing gates.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete post footings.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review sequence of work in area of mechanical yard.
- 2. Review interface between chain link and privacy fence.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Gates and hardware.

- B. Shop Drawings: For each type of fence and gate assembly.

- 1. Include plans, elevations, sections, details, and attachments to other work.
- 2. Include accessories, hardware, gate operation, and operational clearances.

- C. Samples for Initial Selection: For each type of factory-applied finish.

- D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
- E. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For factory-authorized service representative.
- B. Product Certificates: For each type of chain-link fence and gate.
- C. Product Test Reports: For framework strength according to ASTM F1043, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to set quality standards for fabrication and installation.
 - 1. Build mockup for typical chain-link fence and gate, including accessories.
 - a. Size: 8-foot length of fence.

1.7 REFERENCES

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM B117 - Practice for Operating Salt-Spray (Fog) Apparatus.
- C. ASTM D523 - Test Method for Specular Gloss.
- D. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint.
- E. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
- F. ASTM D2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- G. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- H. ASTM D3359 - Test Method for Measuring Adhesion by Tape Test.
- I. ASTM F2408 – Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 15 years from date of Substantial Completion. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
 - 1. Design Wind Load: 120 mph.
 - a. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.
- C. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 SYSTEM DESCRIPTION

- A. Basis-of-Design system: Ameristar Impasse II model, Stronghold design. The system shall include all components (i.e., pales, rails, posts, gates and hardware) required.

2.3 MATERIAL

- A. Steel material for fence framework (i.e., corrugated pales, rails and posts), when galvanized prior to forming, shall conform to the requirements of ASTM A924/A924M, with a minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft² (276 g/m²), Coating Designation G-90.
- B. **B.** Material for corrugated pales shall be a nominal 2.75" x .75" x 14 Ga. The cross-sectional shape of the rails shall conform to the manufacturer's Impasse II[®] rail design a nominal 2" x 2" x 11 Ga. Pre-drilled holes in the Impasse II[®] rail shall be spaced 6" on center, providing a pale airspace of no greater than 3.25" or Pre-drilled holes in the Impasse II Anti-Scale rail shall be spaced 4.1875" on center, providing a pale airspace of no greater than 1.5" (38mm). Tamperproof fasteners shall be used to fasten each pale to rail at every intersection. Fence posts and gate posts shall meet the minimum size requirements of Table 1.
- C. **C.** Material for steel Impasse II privacy screening shall be 18ga. preformed slats, providing complete screening coverage between pales and at pale to post connections. Impasse II privacy screening shall provide screening from top rail to bottom rail, and be capable of traversing terrain without impeding the raking capabilities of the fencing panel. .

2.4 2.03 FABRICATION

- A. **A.** Pales, rails and posts shall be pre-cut to specified lengths. Impasse II rails shall be pre-punched to accept tamperproof security fasteners. Post flange shall be pre-punched to accept rail to post attachment. Post web shall be punched providing a clear opening for interior of rails to align throughout the entire system for affixing conduit, video cabling, IDS wiring, and other components for a complete systems integration. Impasse II rails shall be attached to post flange providing a bracket-less design at each intermediate post.
- B. The manufactured galvanized framework shall be subjected to the PermaCoat[®] thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including, as a minimum, a six-stage pretreatment/wash, an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be (specify Black, Bronze, White, or Desert Sand). The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2.
- C. Completed panels shall be capable of supporting a 400 lb. load (applied at midspan) without permanent deformation. Panels shall be biasable to a 30° change in grade.
- D. Impasse II fence system shall be designed to minimize the system impedance to comply with IEEE grounding requirements. No additional grounding material, beyond the structure grounding lug installation, will be required to create a safe low resistance fence system. By way

of fence construction, the entire fence system is inherently grounded without the need for any additional work. Grounding location at the post is for taking the fence system to site ground.

- E. Swing gates shall be fabricated using 2" sq. x 12ga rail, 2" sq. x 12ga. gate ends, and 2.75" x .75" x 0.075 pales. Gates that exceed 6' in width will have a 2" sq. x 11ga. intermediate upright. All rail and upright intersections shall be joined by welding. All pale and rail intersections shall also be joined by welding.

PART 3 - EXECUTION

3.1 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.2 FENCE INSTALLATION

- A. Fence post shall be spaced according to Table 3, plus or minus ¼". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to the line and end posts with fasteners supplied by the manufacturer. Attachment to corner post shall be made using brackets and fasteners supplied by the manufacturer (See Figure 1). Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.3 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.4 GATE INSTALLATION

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.

3.5 3.05 CLEANING

- A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

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| Table 1 – Minimum Sizes for Impasse II® Posts | | | | |
|--|---------------------------------|---|--|-----------------|
| <u>Fence Posts (Nominal)</u> | | <u>Panel Height</u> | | |
| 3" x 2.75" x 12 Ga. I-Beam | | Up to & Including 8' Height | | |
| 4" x 2.75" x 11 Ga. I-Beam | | Over 8' Height up to & including 10' Height | | |
| <u>Gate Leaf</u> | <u>Gate Height</u> | | | |
| | <u>Up to & Including 6'</u> | <u>Over 6' Up to & Including 8'</u> | <u>Over 8' Up to & Including 10'</u> | <u>Over 12'</u> |
| Up to 4' | 3" x 12Ga. | 3" x 12 Ga. | 4" x 11 Ga. | 4" x 11 Ga. |
| 4'1" to 6' | 3" x 12Ga. | 3" x 12 Ga. | 4" x 11 Ga. | 4" x 11 Ga. |
| 6'1" to 8' | 4" x 11 Ga. | 6" x 3/16" | 6" x 3/16" | 6" x 3/16" |
| 8'1" to 10' | 4" x 11 Ga. | 6" x 3/16" | 6" x 3/16" | 6" x 3/16" |
| 10'1" to 12' | 6" x 3/16" | 6" x 3/16" | 6" x 3/16" | 8" x 1/4" |
| 12'1" to 16' | 6" x 3/16" | 6" x 3/16" | 8" x 1/4" | 8" x 1/4" |

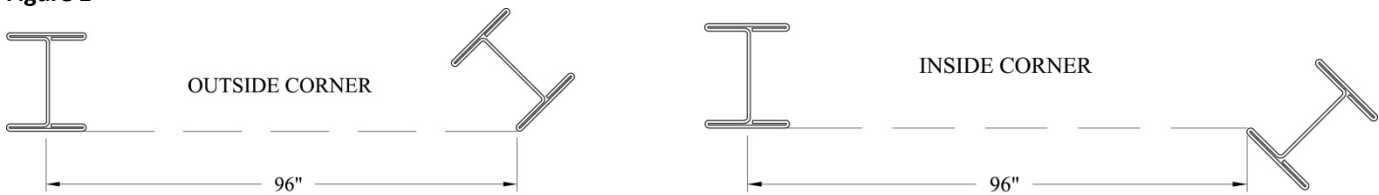
| Table 2 – Coating Performance Requirements | | |
|---|--------------------------|---|
| <u>Quality Characteristics</u> | <u>ASTM Test Method</u> | <u>Performance Requirements</u> |
| Adhesion | D3359 – Method B | Adhesion (Retention of Coating) over 90% of test area (Tape and knife test). |
| Corrosion Resistance | B117, D714 & D1654 | Corrosion Resistance over 3,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters). |
| Impact Resistance | D2794 | Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball). |
| Weathering Resistance | D2244, D523 (60° Method) | Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color) |

| | | |
|--|--|---|
| | | variance of more than 3 delta-E color units). |
|--|--|---|

| Table 3 – Impasse II® Post Spacing | | |
|------------------------------------|----------------------------|----------------------------|
| Span | 8' Nominal (95" Rail) | |
| | Line & End Posts | |
| Post Size | 3" x 2.75" x 12 Ga. I-Beam | 4" x 2.75" x 11 Ga. I-Beam |
| Post Settings ± ¼" O.C. | 96" | 96" |

*For Corner Posts see Figure 1

Figure 1



END OF SECTION 323100

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Chain-link fences.
- 2. Swing gates.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete post footings.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review sequence of work in area of mechanical yard.
- 2. Review interface between chain link and privacy fence.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Gates and hardware.

- B. Shop Drawings: For each type of fence and gate assembly.

- 1. Include plans, elevations, sections, details, and attachments to other work.
- 2. Include accessories, hardware, gate operation, and operational clearances.

- C. Samples for Initial Selection: For each type of factory-applied finish.

- D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
- E. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For factory-authorized service representative.
- B. Product Certificates: For each type of chain-link fence and gate.
- C. Product Test Reports: For framework strength according to ASTM F1043, for tests performed by a qualified testing agency.
- D. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to set quality standards for fabrication and installation.
 - 1. Build mockup for typical chain-link fence and gate, including accessories.
 - a. Size: 8-foot length of fence.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.
 - 1. Design Wind Load: 120 mph.
 - a. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.
- C. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 FENCE FRAMEWORK

- A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 based on the following:
 - 1. Fence Height: 96 inches.
 - 2. Light-Industrial-Strength Material: Group IC-L, round steel pipe, electric-resistance-welded pipe
 - a. Line Post: 1.9 inches in diameter
 - b. End, Corner, and Pull Posts: 2.375 inches
 - 3. Horizontal Framework Members: Top rails according to ASTM F1043.
 - a. Top Rail: 1.66 inches in diameter.
 - 4. Brace Rails: ASTM F1043.
 - 5. Metallic Coating for Steel Framework:
 - a. Type A: 4.0-oz./sq. ft. zinc coating according to ASTM A653/A653M.

2.3 TENSION WIRE

- A. Metallic-Coated Steel Wire: 0.177-inch-diameter, marcelled tension wire according to ASTM A817 or ASTM A824, with the following metallic coating:

1. Type II: Zinc coated (galvanized) by hot-dip process, with the following minimum coating weight:
 - a. Class 4: Not less than 1.2 oz./sq. ft. of uncoated wire surface.

2.4 SWING GATES

- A. General: ASTM F900 for gate posts and single swing gate types.
 1. Gate Leaf Width: 36 inches.
 2. Framework Member Sizes and Strength: Based on gate fabric height of more than 72 inches.
- B. Pipe and Tubing:
 1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework
 2. Gate Posts: Round tubular steel.
 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded.
- D. Hardware:
 1. Hinges: 180-degree outward swing.
 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
 3. Padlock and Chain: Key padlock to Owner's keying system.

2.5 FITTINGS

- A. Provide fittings according to ASTM F626.

2.6 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.7 GROUNDING MATERIALS

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
 - 1. Connectors for Below-Grade Use: Exothermic welded type.
 - 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a certified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 - 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 20 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Concealed Concrete: Place top of concrete 2 inches below grade to allow covering with surface material.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

- E. Line Posts: Space line posts uniformly at 96 inches o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
- G. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
 - 1. Extended along bottom of fence fabric. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
- H. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 GROUNDING AND BONDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fence and Gate Grounding:

1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
 2. Install ground rods and connections at maximum intervals of 1500 feet.
 3. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.
 4. Ground fence on each side of gates and other fence openings.
 - a. Bond metal gates to gate posts.
 - b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- C. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Connections:
1. Make connections with clean, bare metal at points of contact.
 2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 4. Make above-grade ground connections with mechanical fasteners.
 5. Make below-grade ground connections with exothermic welds.
 6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- F. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.
- G. Comply with requirements in Section 264113 "Lightning Protection for Structures."
- 3.6 FIELD QUALITY CONTROL
- A. Testing Agency: Engage a qualified testing agency to perform tests.
 - B. Grounding Tests: Comply with requirements in Section 264113 "Lightning Protection for Structures."
 - C. Prepare test reports.

3.7 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

END OF SECTION 323113

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

- A. Section Includes:

1. Spread and condition existing stockpiled topsoil.
2. Provide new, if required, lime
3. Till, distribute and grade topsoil.
4. Clean up.
5. Do related work necessary to complete the work shown and specified.
6. Submit copies of submittal to the Owner, in triplicate, for review.
7. Submit required samples to a laboratory that is regularly engaged in the analysis of soils and shall be subject to the Owner's approval.

1.3 SUBMITTALS

- A. Laboratory tests: Submit copies of topsoil laboratory tests to the Owner, in triplicate, for review.
- B. Fertilizer: Submit copies attesting to the fertilizer composition to the Owner, in triplicate, for review.
- C. Seed Mix: Submit copies attesting to the seed mix compositions to the Owner, in triplicate, for review.
- D. Sod: Submit copies from the sod source attesting to the seed mix composition to the Owner, in triplicate, for review.

1.4 SITE PROTECTION

- A. Protect existing grounds, plants, lawns and vegetation to remain.
 1. Protect existing trees to remain in place against unnecessary cutting, breaking, skinning, or bruising of roots and bark, smothering of trees by compaction or stockpiling construction materials or excavated materials within five (5) feet of outer edge of drip line.
 - a. Erect minimum of four (4) foot high fence five (5) feet outside drop line of trees to remain.
 - b. Erect tree protection before starting site work of any kind. Maintain fencing during construction period.
 - c. Interfacing branches may only be removed with prior consent from the Landscape Architect.
 - d. Identify any trees Client and/or Landscape Architect would like vertically mulched, trimmed or repaired as result of construction impact at end of project. All work to be done by a certified arborist to be approved by the Client.

2. Water trees and vegetation to remain with one inch of rain (rain gauge or NOAA local weather verified) per week for duration of construction project.
 3. Contractor is responsible for all damage to plants to remain. Cost for tree replacement shall be determined in accordance with the "Guide for Plant Appraisal" by the Council of Tree and Landscape Appraisers (International Society of Agriculture, Publication #P1209).
- B. Temporary Construction Access: Project site access and equipment access routes within the project site must be approved by the Client prior to commencement of work. Any temporary gravel paths or access way must include a geofabric liner to ensure full removal of gravel/stone from project site at project completion.
- 1.5 STRIPPING AND STORAGE OF EXISTING TOPSOIL
- A. Strip topsoil to its full depth at areas impacted and at all areas to be re-graded or resurfaced.
 - B. Stop topsoil stripping outside drip line of trees to remain / do not strip as to impact root line of trees to remain.
 - C. Dispose of roots, stone and other debris; store topsoil in piles within the work limits.
 1. Obtain approval of Client prior to establishing top storage areas.
 2. Grade and slope stockpiles for proper drainage and to prevent erosion.
 - D. The reuse of stockpiled topsoil within the project site must be approved for placement by the Landscape Architect.

PART 2 - PRODUCTS AND MATERIALS

2.1 TOPSOIL

- A. All topsoil shall be shredded, clean, and of uniform quality free from hard clods, stiff clay, partially disintegrated stone, lime, cement, slag, or other undesirable material. Topsoil shall conform to the following:
 1. Organic Content: Topsoil shall contain between 3% and 10% organic matter as determined by loss of ignition.
 2. pH: Topsoil pH shall range between 6.0 and 7.5.
 3. Soil Texture: Topsoil shall consist of the following percentages of sand, silt, and clay passing through a 2.00mm (#10) sieve:
 - a. Sand: 30% to 75%
 - b. Silt: 15% to 70%
 - c. Clay: 10% to 30%
- B. Topsoil must be approved by the Architect prior to placement. Topsoil test results shall show recommendation for soil additives or fertilizers to correct nutrient deficiencies as necessary. All soil amendments must be approved by the Architect prior to use.

2.2 GRASS SEED

- A. Grass seed shall be a turf-type tall fescue blend such as *Simplot Jackson Division "Contractor's Mixture"* or *Grid Iron Mixture*, or approved equal blend with fresh, clean, new crop seed mixtures. Seed mixture to be:
1. 80% Tall Fescue
 2. 10% Kentucky Bluegrass
 3. 10% Perennial Rye
- B. Seed mixture shall be POA-Free meeting Oregon State Standards for noxious weed exams.

PART 3 - EXECUTION

3.1 PREPARATION OF SEED BED

- A. De-compaction: De-compact areas heavily trafficked by construction activities with hoe or other Client approved method prior to rough grading.
- B. Rough Grading: Grade surfaces to assure drainage away from structures and to prevent ponding and pockets of surface drainage. Provide subgrade free from irregular surface changes as follows:
1. Rough grade shall equal plus/minus 0.20 ft., sub grade tolerance shall be free of exposed boulders or stones exceeding 1" in greatest dimension.
 2. Fill in all areas of settlement to proper grade before subsequent placement of topsoil.
- C. Topsoil Depths:
1. Lawn: Areas to receive sod or seed must have minimum seven (7) inches average depth of topsoil placed.
 2. Planted Beds: Areas identified as planting beds shall have minimum fourteen (14) inches average depth of topsoil placed.
- D. Fine Grading: Grade areas to a smooth, free draining even surface with a loose, moderately course texture. Roll, scarify, rake, and level as necessary to obtain a true, even lawn surface and fill depressions as required to drain. Seed bed to be approximate ½" – 1" below all sidewalks and curbs. Do not move heavy objects except necessary lawn making equipment over the lawn areas after the soils is prepared unless it is loosened and re-graded. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading.

3.2 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. The landscape contractor shall seed all disturbed areas or areas that do not have a thick, healthy stand of grass.
 2. The final grade and topsoil shall be within 0.10 feet +/- prior to beginning hydroseed application.
 3. Mix slurry with cellulose fiber-mulch.
 4. Apply slurry uniformly to all areas to be seeded in a one-step process at the following rate:

- a. Cellulose Fiber Mulch – 1500-lb/acre dry weight.
 - b. Best 6-20-20 or Best 15-15-15 at appropriate rate.
 - c. Organic Tackifier – 70-lb/acre.
 - d. Seed Mix – 2,000-lb/acre.
5. Water all planting areas thoroughly to saturate the upper levels of soil prior to the hydroseeding operation. Allow the planting area soils surface to dry out for one day only prior to the hydroseeding operation.
 6. Apply hydroseed in the form of a slurry. When hydraulically sprayed onto the soil, the mulch shall form a blotter-like material. Spray the area with a uniform, visible coat, using a dark colored cellulose fiber as a visual guide.
 7. Apply slurry in a downward drilling motion via a fan stream nozzle.
 8. Ensure that all of the slurry components enter and mix with the soil.
 9. If the slurry components are left in the machine longer than two hours after mixing, add an additional 50% of the original seed mix to the slurry mix that has not been applied within two hours after mixing. Add 75% of the original seed mix to the slurry mixture if the slurry mixture has not been applied within 8 hours of mixing. All mixes over 8 hours old shall be disposed of offsite at the contractor's expense.
 10. Contractor shall remove all slurry sprayed onto hardscape areas including concrete walks, fences, walls, buildings, etc. at the contractor's expense.
 11. Contractor shall have all seed, fertilizer, and fiber mulch tags for the landscape architect to verify compliance with the drawings and specifications.

3.3 MAINTENANCE

- A. Watering and maintenance activities must be reviewed and approved with the Client. Unless otherwise approved, the following requirements are to be completed at a minimum:
 1. Maintain new installed seeded/sodded lawn areas in an acceptable manner until final acceptance of project, including watering, spot weeding, mowing, trimming, removal of clippings, leaf removal, application of herbicides, fungicides, insecticides, and re-seeding until a full, uniform stand of grass free of weed, undesirable grass species, disease, and insects is achieved and accepted by the Landscape Architect.
 2. Water daily to maintain adequate surface soil moisture for proper seed germination. Continue daily watering for not less than thirty (30) days. Thereafter apply one-half (1/2) inch water every two or three days until accepted.
 3. Repair, re-work, re-seed, and or sod all respective areas that have washed out, are eroded, or did not catch.
 4. Set mower blades at a minimum height of two and one-half (2-1/2) inches. Not more than (30) percent of the grass leaf/blade shall be removed at the initial or subsequent mowing. Mow all lawns before turf reaches a height of four (4) inches.
 5. If infestation of weeds or crabgrass develops, treat infestation by hand weeding or herbicidal control. Furnish and install weed chemical control as recommended by manufacturer. Herbicidal controls, including renovation before seeding operations, shall be acceptable to the Client.
 6. Apply Type B fertilizer to lawns approximately thirty (30) days after installation at a rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft. Apply with mechanical drop or rotary type distributor. Water fertilizer thoroughly into the soil.
- B. Provide erosion control measures to adequately slow water and impede soil loss as directed by the Client.
 1. Erosion Control Blankets to be used on seeded slopes greater than 3:1.
 2. Fiber Rolls to be used on seeded slopes greater than 2:1.
 3. Straw bale checking or other approved device in ditches or eroded swales as required.

3.4 ACCEPTANCE

- A. Inspection to determine acceptance of installed lawns will be made by the Architect, upon Contractor's request. Provide notification at least three (3) working days before requested inspection date.
1. New lawn areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy uniform, close stand of grass is established free of weeds, undesirable grass species, disease and insects.
 2. No individual lawn areas shall have bare spots or unacceptable cover totaling more than two (2) percent of the individual areas, in those areas requested for inspection.
 3. Upon acceptance, the School will assume lawn maintenance.

END OF SECTION 329200