

OHC Project CP 2140

Harriet Beecher Stowe House Interior Restoration

2950 Gilbert Ave
Cincinnati, Hamilton County, Ohio 45206

PROJECT MANUAL



Ohio History Connection
800 E. 17th Avenue
Columbus, Ohio 43211

Megan Wood
Executive Director

Jen Aultman,
Chief Officer
Historic Sites

Fred R. Smith, RA
Director
Buildings and Grounds

Sara Vandebark
Project Manager

January 20, 2023

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 Harriet Beecher Stowe House
 Interior Restoration

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SECTION 00 11 16 NOTICE TO BIDDERS

Sealed Bids will be received at:

The Ohio History Connection
Historic Sites and Facilities Division
800 E 17th Avenue, Columbus, Ohio 43211

until Thursday 2/16/2023 at 2:00 PM local time (Owner’s clock) and opened immediately thereafter for:

OHC Project No. CP 2140
Harriet Beecher Stowe House
Interior Restoration
Cincinnati, Hamilton County, Ohio 45206

OHC intends to award the project to one successful Bidder. The Owner intends to award 1 contract to 1 bidder for the project. The Instructions to Bidders, Bid Form, Form of Contract, Drawings, Specifications, and other contract documents may be examined at:

Historic Sites and Facilities
The Ohio History Connection
800 E. 17th Avenue
Columbus, Ohio 43211

Bid Documents will be available electronically and as hardcopy on 1/20/23.

Obtain the electronic versions by registering on the plan holders list and downloading documents from the OHC website at: www.ohiohistory.org/hsfprojects.

Direct all questions and comments to the OHC Project Manager:

Ms Sara Vandembark
V: (614) 297-2447
F: (614) 297-2455

A mandatory pre-bid conference will be held on Thursday 2/2/2023 at 11:00 AM at the following location:

Harriet Beecher Stowe House
2950 Gilbert Ave
Cincinnati, Ohio 45206

The final date questions are due to the Architect (if you wish to guarantee answer in final Addendum is: Monday, February 13 at 12:00 noon.

The anticipated project cost is \$500,000.

A Bid Guaranty and Contract Bond are required as defined in the Contract Documents. Prevailing wage rates for Hamilton County as determined by the State of Ohio, Department of Commerce, Division of Labor and Safety will be applicable to this Work.

No bids may be withdrawn within ninety (90) days after the Bid Opening. The Owner reserves the right to waive irregularities and to reject any or all bids.

END OF SECTION

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SECTION 00 21 13 INSTRUCTIONS TO BIDDERS

OHC Project No. CP 2140
Harriet Beecher Stowe House
Interior Restoration

PART 1 - GENERAL

1.1 INSTRUCTIONS

- A. To be considered, bids must be made in accordance with these Instructions to Bidders.

1.2 DOCUMENTS

- A. For instructions on obtaining bid documents, see section 00 11 16 Notice to Bidders. Documents are available at no cost by downloading them from the OHC website at: www.ohiohistory.org/hsfprojects.
- B. Direct questions to OHC Project Managers, as noted in section 00 11 16 Notice to Bidders.

1.3 EXAMINATION

- A. Before submitting a bid, Bidder shall carefully examine the documents and the construction sites to obtain firsthand knowledge of the existing conditions. Contractors will not be given extra payment for conditions which can be determined by examining the site and documents.
- B. Bidders may make arrangements to visit the site and inspect existing conditions during business hours Monday through Friday by calling Ms Sara Vandebark at (614) 297-2447.
- C. A pre-bid conference for all interested parties will be held as provided in the Notice to Bidders.

1.4 PREPARATION OF BIDS

- A. Bids shall be made on an unaltered Bid Form provided in the Bid Documents. Fill in all blank spaces and submit one (1) original. Bids shall be signed with name typed or printed below signature. Where Bidder is a corporation, follow by the name of the state of incorporation and the legal signature of an officer authorized to bind the corporation to a contract.
- B. The Bidder must include prices for all alternates, substitutions, and unit costs on the Bid Form, if any. Failure to comply may be cause for rejection.

1.5 BID GUARANTY AND CONTRACT BOND

- A. Bid Guaranties and Contract Bonds must be satisfactory to the Ohio History Connection.
- B. The BID GUARANTY AND CONTRACT BOND form provided herein by the Ohio History Connection shall be used without change.
- C. If the amount is left blank, the penal sum of the Bid Guaranty and Contract Bond will be the full amount of the principal's base bid plus add alternates; alternatively, if complete, the amount must be not less than the full amount of the base bid plus add alternates, stated in dollars and cents. A percentage is not acceptable.
- D. The Bid Guaranty and Contract Bond must be signed by an Authorized Agent of an acceptable Surety Bonding Company and by the Bidder. A surety company authorized by the Ohio Department of Insurance to transact business in the State of Ohio must issue the bond. It is essential that the bond be issued by a surety company which can adequately demonstrate a record of competent underwriting, efficient management, adequate reserves and soundness of investments as demonstrated by Best's Insurance Reports rating of A- or better.
- E. Bid Guaranties and Contract Bonds must be supported by credentials showing the following:
 - 1. Power of Attorney of the Agent.
 - 2. Corporate Seals must be affixed to all originals and certified copies.
- F. In lieu of the Bid Guaranty referred to in Paragraph 1.05, B. above, the bidder may submit the Bid Guaranty in the form of a Certified Check, Cashier's Check or Letter of Credit. A bid bond is not acceptable for use as a Bid Guaranty.
 - 1. The amount of the Certified Check, Cashier's Check or Letter of Credit shall be equal to ten percent (10%) of the base bid plus add alternates.
 - 2. The Bid Guaranty shall be payable to the Ohio History Connection.
- G. The Bid Guaranty and Contract Bond shall be returned to all unsuccessful bidders immediately after the Contract is executed.
- H. The Certified Check, Cashier's Check or Letter of Credit shall be returned to the successful bidder upon filing of the Contract Bond. The bond shall not be deemed "filed" until the Contract is fully executed.

1.6 SUBMITTAL

- A. Submittals AT Bid:
 - 1. Submit Bid Forms in an opaque, sealed envelope. Identify the envelope with:
 - a) OHC project number
 - b) Project Name
 - c) Bidder's Company Name
 - d) The phrase, "Sealed Bid Enclosed – Attn: Historic Sites and Facilities"
 - 2. Submit bids in accordance with the Notice to Bidders. A faxed Bid will not be accepted.

3. With bid, submit a Responsible Bidder Information Form, per specification section 00 45 13; Bid Guaranty and Contract Bond per specifications, and Preferred Business Enterprise Form per section 00 45 39.

1.7 OHIO SALES TAX

- A. Material purchased for use or consumption in connection with the proposed work will be exempt from the State of Ohio Sales Tax as provided for in Section 5739.02 in the Revised Code of Ohio, and also from the State of Ohio Use Tax, Section 5741.01.
- B. Purchases by the Contractor of expendable items such as form lumber, tools, oils, greases, fuel, or equipment rentals are subject to the application of the Ohio Sales or Use Tax.

1.8 WAGE RATES

- A. The wages to be paid for a legal days work to laborers, workmen or mechanics engaged in the work under this contract at the site of the project for the trade or occupation employed shall not be less than the wage rates set forth by the Department of Employment Services of the State of Ohio in effect for Hamilton County, as of the date bids are received for the project. Reference wage rates as listed herein.

1.9 DOCUMENTS REQUIRED PRIOR TO SIGNING CONTRACT

- A. Immediately upon the award of, and prior to the signing of the contract, the successful bidder shall furnish to the Architect:
 1. A Schedule of Values (AIA Document G703, Continuation Sheet) for various categories of work showing itemized labor and material amounts for the total contract price. The Schedule of Values must clearly indicate separate costs for each building project. Further, each separate cost must indicate proper allocation for materials and labor for each line item.
 2. Certificates of Insurance from company insuring the work.
 3. Worker's Compensation Certificate.
 4. To support the Bid Guaranty and Contract Bond, the successful bidder shall also furnish the following:
 - a. Credentials showing the Power of Attorney.
 - b. A Certificate of Compliance issued by the Division of Insurance showing the Bonding Company is licensed to do business in the State of Ohio.
 - c. Financial statement of Bonding Company.
 5. List of all Sub-contractors
 - a. Sub-Contractors are expected to meet the same performance standards as the General Contractor. At their discretion, the Architect may request a Responsible Bidder Form from any sub-contractor.
 6. Construction Schedule
- B. If the successful bidder is a foreign corporation, i.e. not incorporated under the laws of

Ohio, the Bidder shall also furnish:

1. A certificate from the Secretary of State showing the right of the successful bidder to do business in the State of Ohio.
2. If the successful bidder is a domestic or foreign corporation, the person signing as agent such contract for the corporation shall, upon the Owner's request, file legal evidence of the agent's authority to bind the corporation.

1.10 AWARD OF CONTRACT

- A. The Owner reserves the right to accept any bid, to reject any and all bids, and to negotiate contract terms with the various bidders.

1.11 TIME OF COMPLETION

- A. Complete all work in the time period established in the Supplementary Conditions.

1.12 STATE OF OHIO RESPONSIBILITY

- A. Each party hereto recognizes and agrees that the Ohio Facilities Construction Commission, the Ohio Building Authority, the Ohio Department of Administrative Services and the State of Ohio are not bound by or liable under this contract or license, as applicable, and are not responsible for the acts or omissions of the Ohio History Connection.

1.13 FACILITY CLASSIFICATION REGARDING LEAD-BASED PAINT

- A. This building is not classified as a "child occupied" facility use, as defined by the U.S. Environmental Protection Agency (EPA) Renovation, Repair and Painting (RRP) program (ref.: 40 CFR 745.82); therefore the requirement of the EPA Residential Property Renovation program regulation 40 CFR745.80, Subpart E as well as Ohio lead abatement regulations which require lead-safe work practices and worker certification, are not applicable to this project. The contractor shall however, minimize dust and debris caused by work activity, contain it to the smallest practical areas, and to promptly and thoroughly clean the areas to eliminate dust and debris.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION

SECTION 00 26 00 SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for substitutions submitted with a Bidder's Bid.

1.2 DEFINITIONS

- A. Definitions in this Section do not change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: change in product, material, equipment, or method of construction required by the Contract Documents or any portion thereof, proposed by a Bidder and submitted with its bid.
 - 1. Substitutions requested and accepted during the bidding period, are included in the Contract Documents and are not subject to requirements in this Section for substitutions.
 - 2. Revisions to the Contract Documents requested by the Owner or Architect.
 - 3. Specified options of products and construction methods included in the Contract Documents.
 - 4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.3 SUBMITTALS

- A. Substitution Request Submittal:
 - 1. Submit with the bid 3 copies of each request for substitution for consideration. Submit requests in a form acceptable to the Architect. Include, as a minimum, the following information:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors that will be necessary to accommodate the proposed substitution.
 - b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.

- c. Product data, including drawings and descriptions of products and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - e. A statement indicating the effect on the Contractor’s Construction Schedule of the using of the proposed substitution, compared to the schedule without approval of the substitution. Also, indicate the effect of the proposed substitution on the overall Contract Time.
 - f. Cost information, including a proposal of the net change, if any, in the Contract Sum.
 - g. The Contractor’s certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
 - h. The Contractor’s waiver of rights to additional payment or time that may subsequently become necessary to perform adequately.
2. The Architect may request additional information or documentation for evaluation. The Architect will notify the Contractor of acceptance or rejection of the proposed substitution within 2 weeks of receipt of the request or one week of receipt of additional information or documentation, whichever is later.

PART 2 – PRODUCTS

2.1 SUBSTITUTIONS

- A. The Architect will accept a request for substitution when one or more of the following conditions are satisfied, as determined by the Architect. If one or more of the following conditions are not satisfied, the Architect will return the request without action except to record noncompliance with these requirements.
- 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents.
 - 3. The request is timely, fully documented, and properly submitted.
 - 4. The specified product or method of construction cannot be provided within the Contract Time. The Architect will not consider the request if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
 - 5. The request meets the requirement of an “or-equal” clause or similar language in the Contract Documents.

6. The requested substitution offers the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. The Owner’s additional responsibilities may include compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner, and similar considerations.
 7. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies the proposed substitution will overcome the incompatibility.
 9. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.
 10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
- B. The Contractor shall bear all costs for work not identified or reasonably implied in its proposal to the Owner, including and not limited to modification to the project site, new and existing construction, and construction components.

PART 3 – NOT USED

END OF SECTION

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SECTION 00 41 13 FORM OF PROPOSAL – STIPULATED SUM

OHC Project No. CP 2140
Harriet Beecher Stowe House
Interior Restoration

TO: The Ohio History Connection
Director of Facilities Management
800 E 17th Avenue
Columbus, Ohio 43211

PART 1 - GENERAL

By submitting this Bid, Bidder acknowledges its receipt of all Addenda, which it has listed below and that the absence of the Bidder’s acknowledgement of receiving all Addenda may be cause, in the Owner’s sole discretion, for the Owner not to accept the Bid.

Bidder: list below each Addenda and its respective issue date in the spaces provided. Attach additional sheets if necessary.

Addendum # _____ Date _____
Addendum # _____ Date _____
Addendum # _____ Date _____

The undersigned Bidder hereby agrees to accept the award of the Contract if offered, and to timely commence and perform the Work, provided the award occurs within a reasonable time after the Bid Opening.

BIDDER: _____ COMPANY NAME

ADDRESS

TELEPHONE NUMBER WITH AREA CODE

FEDERAL TAX ID NUMBER

NAME OF OFFICER or OWNER

(Type or Print)

SIGNATURE

OFFICE

DATE

PART 2 – PROPOSAL

2.1 **BASE BID:** Woodwork restoration, stair reconstruction, and mantel installation

Bid _____ Dollars
 (Bidder: type or clearly print total proposal in words)
 (\$_____)

2.2 Not Used

2.3 Not Used

2.4 PERIOD OF PERFORMANCE / LIQUIDATED DAMAGES

- A. The Period of Performance and Liquidated Damage rates are indicated in the Supplementary Conditions.
- B. Bidder may propose a different Period of Performance as a Substitution below.

2.5 SUBSTITUTIONS

- A. Bidder may propose up to three substitutions below. Provide additional sheets as necessary to accurately describe the substitution. If accepted by the Owner, a substitution shall be incorporated in the Bid and Contract and shall be bound by all Contract provisions.

Proposed Substitute		Add	Deduct
1.			
2.			
3.			

2.6 SUCCESSFUL BIDDER ASSISTANCE AND COOPERATION

- A. The accepted Bidder shall assist and cooperate with the Owner in preparing the Agreement, and within seven (7) days following presentation of the Agreement to the successful Bidder, the successful Bidder shall execute three (3) originals and return them to the Owner.

END OF SECTION

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**BID GUARANTY
AND
CONTRACT BOND**

The Bid Guaranty and Bid Bond form for use on this project is provided on the double-sided sheet that follows this page.

A PDF version is attached.

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Bid Guaranty and Contract Bond

OHIO HISTORY CONNECTION • Historic Sites and Facilities Division • 800 E. 17th Ave. • Columbus, Ohio 43211-2497

Section 153.571 Ohio Revised Code

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned

_____ as Principal

and

_____ as Surety

are hereby held and firmly bound unto the Ohio History Connection as Obligee in the penal sum of the dollar amount of the bid submitted by the Principal to the Obligee on:

_____ to undertake the project known as:
Type or print date of bid submittal

_____ OHC Project number

_____ OHC Project Name

The penal sum referred to herein shall be the dollar amount of the Principal's bid to the Obligee, incorporating any additive and deductive alternate proposals made by the Principal on the date referred to above to the Obligee, which are accepted by the Obligee. In no case shall the penal sum exceed the amount of

_____ \$ _____
Type or print amount first in words, then numbers

(When the line above is left blank, the penal sum will be the full amount of the Principal's Bid including alternates. When the line above indicates an amount, the amount stated must not be less than the full amount of the Bid including alternates in dollars and cents; a percentage is not acceptable.)

for the payment of the penal sum well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH that whereas the above named Principal has submitted a bid on the above-referred project,

NOW, THEREFORE, if the Obligee accepts the bid of the Principal and the Principal fails to enter into a proper contract in accordance with the bid, plans, details, specifications, and bills of material; and in the event the Principal pays to the Obligee the difference not to exceed ten percent of the penalty hereof between the amount specified in the bid and such larger amount for which the Obligee may in good faith contract with the next lowest bidder to perform the work covered by the bid; or in the event the Obligee does not award the contract to the next lowest bidder and resubmits the project for bidding, the Principal will pay the Obligee the difference not to exceed ten percent of the penalty hereof between the amount specified in the bid, or the costs, in advertising and printing and mailing notices to prospective bidders, whichever is less, then this obligation shall be null and void, otherwise to remain in full force and effect. If the Obligee accepts the bid of the Principal and the Principal, within ten days after the awarding of the contract, enters into a proper contract in accordance with the bid, plans, details, specifications, and bills of material, which said contract is made a part of this bond the same as though set forth herein; an



Bid Guaranty and Contract Bond

continued

OHIO HISTORY CONNECTION ▪ Historic Sites and Facilities Division ▪ 800 E. 17th Ave. ▪ Columbus, Ohio 43211-2497

OHC Project: _____ OHC Project Name: _____

NOW ALSO, if the Principal shall well and faithfully perform each and every condition of such contract; and indemnify the Obligee against all damage suffered by failure to perform such contract according to the provisions thereof and in accordance with the plans, details, specifications, and bills of material therefore; and shall pay all lawful claims of subcontractors, materials suppliers, and laborers, for labor performed and materials furnished in the carrying forward, performing, or completing of said contract; we agreeing and assenting that this undertaking shall be for the benefit of any materials supplier or laborer having a just claim, as well as for the Obligee herein; then this obligation shall be void; otherwise the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

THE SURETY HEREBY STIPULATES AND AGREES that no modifications, omissions, or additions, in or to the terms of said contract or in or to the plans and specifications therefore shall in any wise affect the obligations of said Surety on its bond, and it does hereby waive notice of any such modifications, omissions or additions to the terms of the contract or to the work or to the specifications.

BOND NUMBER: _____

SIGNED AND SEALED this _____ day of _____, 20_____

PRINCIPAL

SURETY

Type or type authorized officer or owner name and title

Type or print Agent's name and title

Signature (seal)

Signature (Attorney-in-Fact) (seal)

Surety Company Address and Telephone:

Surety Agent's Address and Telephone:

Street

Street

City, State, Zip

City, State, Zip

Telephone with Area Code

Telephone with Area Cod

NOTE: Failure by any party to sign Bid Guaranty and Contract Bond shall result in rejection of bid.

SECTION 00 43 39 PREFERRED BUSINESS AND WORKFORCE PARTICIPATION

PART 1 – ATTENTION ALL BIDDERS

1.1 RELATED SECTIONS: 00 45 39 Preferred Business Bidder Form

1.2 IMPORTANCE OF THIS SECTION

- A. The Ohio History Connection in response to its core values and under the sole discretion of the Director of Historic Sites, has created an Ohio History Connection Equal Opportunity clause to insure that all its construction activities reflect those standards including:
 - Relevance - Addressing and communicating the significance of history with Ohio's diverse people.
 - Authenticity - Valuing artifacts and true stories of history
 - Inclusivity - Appealing to all Ohioans, especially underserved audiences
 - Stewardship - Protecting the evidence of Ohio history
 - Working Together - Pursuing teamwork and sharing authority and responsibility

PART 2 – PREFERRED BUSINESS AND WORKFORCE GOALS AND PREFERENCES

2.1 CERTIFICATION

- A. Each PBE must be certified or approved by an acceptable entity.
 1. By DAS EEO:
 - Minority Business Enterprise (MBE)
 - Woman Business Enterprise (WBE)
 - EDGE Business (EDGE)
 2. By OHC:
 - District Business (Dist) – For this projects, the District is defined by the borders of the Walnut Hills as determined by the City of Cincinnati.
 - City of Cincinnati Business (City)
 - Hamilton County Business (County)
 - Standard Metropolitan Statistical Area Business (SMSA Bus) – For this project, the SMSA is defined by the United States Office of Management and Budget, see Appendix 2 .

2.2 GOALS AND PREFERENCES

- A. Goals and preferences have been established for the following Preferred Business categories:

Business Participation, Goals and Preference							
	MBE	WBE	EDGE	Dist	City	County	SMSA
Goals	20.0%	10.0%	12.0%	12.0%	15.0%	25.0%	40.0%
Pref.	2.00%	1.00%	1.00%	3.00%	1.50%	1.00%	0.50%

- B. Goals and preferences have been established for the following Preferred Workforce categories:

Workforce Participation Goals and Preference							
	Minorities	Females	Apprentices Trainees	Dist Residents	City Residents	County Residents	SMSA Residents
Goals	12.0%	7.0%	20.0%	15.0%	20.0%	40.0%	50.0%
Pref	1.50%	0.25%	0.75%	1.00%	0.75%	0.50%	0.25%

- C. How Participation counts toward goals:
1. Contractor/Subcontractor
 - a. Count 100% of a contractor or subcontractor’s portion of work.
 - i. Subcontractors and their subcontractors may only be counted if they are qualifying PBE’s.
 - ii. All contractors or subcontractors that qualify must be performing a commercially useful function on the contract to be eligible.
 - b. Count 100% of fees and commissions charged by for services provided by a PBE firms including but not limited to: professional, technical, consulting, managerial, bonding agent, etc. Entire amount is to be counted provided the fee is determined reasonable and within the standards of that field.
 - c. Joint Ventures: only the portion of work performed by the PBE member of the joint venture can be counted toward goals.
 - d. Trucking Companies with their own drivers fall under “subcontractor” for the purposes of this program and they must comply with all of the above requirements to count towards goals. Otherwise, leased trucks without drivers falls under “Leased Equipment”
 - e. Leased Equipment: PBE’s that supply leased equipment count as a “Supplier”, see below.
 2. Manufacturer
 - a. Count 100% of the cost of materials or supplies obtained from a PBE manufacturer toward goals.
 - b. A Manufacturer is defined as a firm that operates or maintains a factory or production establishment that produces on its premises materials, supplies, or equipment required by the contract.
 3. Supplier
 - a. Regular Dealers: Count 60% of the cost of materials or supplies purchased toward goals.
 - i. For the purpose of this program, a regular dealer is defined as an established business engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question.
 - ii. Packagers, brokers, and representatives do not count as regular dealers.

- b. Non-regular Dealer: Count the entire amount of fees or commissions charged for assistance in the procurement of materials and/or supplies.
- 4. Workforce
 - a. The contractor shall ensure equal employment opportunity.
 - b. Only employees that work on the project or managing the project shall count towards goals. This does not include office staff or other staff that is considered “overhead”.
- D. How Preference counts toward bid review:
 - 1. Percentage achieved in each category is multiplied by the Preference Factor, creating the Preference Percentage for that category. The sum of all preference percentages (both Business and Workforce) are then multiplied by the bid amount. The resultant preference amount is then subtracted from the bid and that number is counted as the bid during the review.

2.2 GOOD FAITH EFFORT

- A. A bidder must, in order to be responsible and responsive, make sufficient good faith efforts to meet the goal and must show all necessary and reasonable steps it undertook to achieve the PBE goal, even if they were not fully successful.
- B. Examples of Good Faith Efforts Include:
 - 1. The Bidder utilized reasonable and available means to solicit all PBEs that have the capability to perform work under the contract.
 - 2. The Bidder selected portions of the contracted work that would increase the likelihood of participation by PBEs.
 - 3. The Bidder provided all appropriate PBEs with adequate information about the plans, specifications and requirements of the contract in time for PBE’s to provide price quotations for the project.
 - 4. The Bidder negotiated in good faith with interested PBEs. To demonstrate good faith effort negotiations, the Bidder shall provide evidence of such negotiations, including but not limited to names, addresses, dates, and telephone numbers of the PBE.
 - 5. The Bidder properly rejected an interested PBE as being unqualified for the work of the contract. Rejection of a PBE based on standing within appropriate industry or membership of affiliation in a business, social, or political group is not a basis for rejection.
 - 6. The Bidder utilized the services of one or more organizations that provide contractor assistance in the identification and recruitment of PBEs.
 - 7. The Bidder utilized the list of PBE’s as provided by the Equal Employment Opportunity Division of the Department of Administrative Services. See Part 4 Resources.

PART 3 – BIDDING AND CONTRACT REQUIREMENTS

3.1 SUMMARY OF REQUIRED BIDDER ACTIONS

- A. All Bidders are required to show the following in their bids to show Good Faith Effort:

1. Participation and Commitment Form: the bidder is committing to achieving PBE participation goals.
 - a. Bidders not achieving the listed PBE goals shall show verifiable Good Faith Effort in reaching out to PBE's to participate in the project during the Pre-Award Review.

3.2 PRE-AWARD REVIEW

- A. All documents required for the Pre-Award review shall be submitted within (14) calendar days of the bid opening. Failure to submit the required documents may result in rejection of that bid.
- B. Preferred Business Utilization Form listing all participating PBE's.
 1. Bidders shall provide copies of Preferred Business Certification for all tentative project PBE's.
- C. Demonstration of Good Faith Effort Form
 1. All PBE's outreached shall be listed on the Good Faith Effort form. Owner reserves the right to contact all Preferred Business firms in bid documents for verification.

3.3 AWARD

- A. Providing, within (14) calendar days after receiving an approved contract, bidding contracts with all Preferred Business firms on the project. Contracts shall include:
 1. Date of contract
 2. Project Name
 3. Scope of Work
 4. Contract total amount
- B. Throughout the duration of the project, the Contractor must submit along with each monthly pay request, a copy of the Affidavit of Contractor Payment Form for each PBE subcontractor and material supplier receiving payment from the previous month's approved pay request. Failure to do so will result in denial of pay request. Failure to meet guaranteed participation will result in denial of pay request, which will not be approved until participation is corrected.

3.4 PREFERRED BUSINESS PARTICIPATION FINAL REPORT

- A. The Contractor shall provide a certified Affidavit of Contractor Final Report for payments made to each PBE subcontractor and material supplier that participated on this Contract. This report shall include, but not be limited to, the following items:
 1. Name of each PBE business;
 2. Original amount of the PBE business contract or purchase order with the Contractor;
 3. Current amount of the PBE business contract or purchase order;
 4. The amount of the invoice to date;
 5. The amount paid to date; and

6. A statement describing any substantive product or performance deficiencies.

- B. This report must be submitted along with the Contractor’s Final Pay request, in accordance with the Contract. Failure to submit this report may delay final payment and closeout of the Contract.

PART 4 – PREFERRED BUSINESS RESOURCES

4.1 DEPARTMENT OF ADMINISTRATIVE SERVICES

A. To view a list of Preferred Business vendors:

1. Visit the MBE, EDGE, and WBE certification website at <https://eodreporting.oit.ohio.gov/> for the latest list.
2. Preferred Business resources available: <http://www.das.ohio.gov/Divisions/Equal-Opportunity>

4.2 PREFERRED BUSINESS ASSISTANCE ORGANIZATIONS

- A. Ohio Minority Supplier Development Council
1. The Chase Building; 100 E Broad St Suite 2460, Columbus, Ohio 43215 Phone: (614)225-6959
- B. Ohio Department of Development Minority Business Assistance Centers
3. Central Ohio Minority Business Association, 1393 East Broad Street, Floor 2, Columbus, OH 43205 Phone: (614) 252-8005 Fax: (614) 258-9667

END OF SECTION

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SECTION 00 45 13.A RESPONSIBLE BIDDER INFORMATION FORM – GENERAL CONTRACTOR

OHC Project No. CP 2140
Harriet Beecher Stowe House
Interior Restoration

Attach additional pages as needed.

1. Company Name _____

Company Address _____
Street _____

City _____ State _____ Zip _____

Company Telephone Number (w/ Area Code) (_____) _____

Company Fax Number _____

Company Email _____

2. Indicate the overall experience of the Bidder performing the trades bid including the years in business performing the trade under present and former business names.

3. List three projects that the Bidder has completed that are similar in scope to the current project. Include contact information.

	Project	Scope	Value	Contact
a)				
b)				
c)				

7. List all ongoing Projects and Projects completed in the last four (4) years which are similar in cost and type to the Project being bid. Include scope of Work, Contract value and Project name/contact Person/address/phone number for each Owner and Associate for each Project.

Project	Scope	Value	Contact
---------	-------	-------	---------

a)

b)

c)

d)

8. Indicate all occurrences of the following in the last four (4) years (if none, so state). For verification by the State, attach documentation, and/or provide sufficient and appropriate detail information such as: Project name, Owner, contact person and phone number, Contract amount, etc.

a) Prevailing Wage violations or judgments

b) Affirmative Action violations

c) Contract abandonment, Contract termination or Surety takeover

d) Debarment by State, federal or local jurisdictions

e) EPA/OSHA violations

f) Liquidated damages assessed

9. Management. Identify individuals assigned to this project.

Principal _____ Years with firm _____ Total Exp. _____

Project Manager _____ Years with firm _____ Total Exp. _____

Field Superintendent _____ Years with firm _____ Total Exp. _____

CPM Scheduler _____ Years with firm _____ Total Exp. _____

10. Certification. I hereby certify that the information above is factual and complete.

Company Name _____

Authorized Official (please print or type) _____

Signature of Authorized Official _____ Date _____

END OF SECTION

SECTION 00 45 39 PREFERRED BUSINESS ENTERPRISE BIDDER FORM

Harriet Beecher Stowe House
Interior Restoration

PART 1 – PARTICIPATION COMMITMENT – DUE AT BID

We, _____ (Company),

recognizing the OHC goal of commitment to Preferred Business Enterprise (PBE) participation,
accordingly we do certify that our company will be committed to PBE participation.

The undersigned will enter into a legal agreement with the listed PBE subcontractors or suppliers, and workforce for work listed in this schedule, conditioned upon execution of a contract with OHC. The undersigned will demonstrate binding commitments with the subcontractors or suppliers listed within fourteen (14) calendar days after receiving approved contract from OHC. The undersigned will ensure certification of the listed PBE’s to be submitted with this bid package. If changes are required, the bidder must contact OHC for prior review and approval.

The undersigned, upon award of the contract, will work with OHC to achieve the listed goals under Preferred Workforce for Minorities, Women, Apprentices, and local labor participation.

The undersigned hereby certifies that he/she has read the terms of this commitment and is authorized to bin the bidder to the commitment herein set forth.

Signature Date

Print/Type Name Title

PART 2 – SUBCONTRACTOR/SUPPLIER UTILIZATION COMMITMENT FORM

Contract Amount: _____	Cert.	Type
Company: _____	<input type="checkbox"/> MBE	<input type="checkbox"/> Subcontractor
Address: _____	<input type="checkbox"/> WBE	<input type="checkbox"/> Manufacturer

Contract Amount: _____	Cert.	Type
Company: _____	<input type="checkbox"/> MBE	<input type="checkbox"/> Subcontractor
Address: _____	<input type="checkbox"/> WBE	<input type="checkbox"/> Manufacturer

Contract Amount: _____	Cert.	Type
Company: _____	<input type="checkbox"/> MBE	<input type="checkbox"/> Subcontractor
Address: _____	<input type="checkbox"/> WBE	<input type="checkbox"/> Manufacturer

Contract Amount: _____	Cert.	Type
Company: _____	<input type="checkbox"/> MBE	<input type="checkbox"/> Subcontractor
Address: _____	<input type="checkbox"/> WBE	<input type="checkbox"/> Manufacturer

Contract Amount: _____	Cert.	Type
Company: _____	<input type="checkbox"/> MBE	<input type="checkbox"/> Subcontractor
Address: _____	<input type="checkbox"/> WBE	<input type="checkbox"/> Manufacturer
City: _____ County: _____	<input type="checkbox"/> EDGE	<input type="checkbox"/> Supplier
Scope of Work: _____		

PART 3 – WORKFORCE PARTICIPATION GUARANTEE

Workforce Participation							
Total Number of Employees:							
	Minorities	Females	Apprentices Trainees	Dist Residents	City Residents	County Residents	SMSA Residents
Total % Companywide							

Guaranteed Participation % On Site							
--	--	--	--	--	--	--	--

PART 4 – GOOD FAITH EFFORT DEMONSTRATION

- I have made all efforts to reach all minority subcontractors and material suppliers.
- I *have* achieved OHC’s listed PBE goals.
- I *have partially* achieved OHC’s listed PBE goals.
- I *have not* achieved OHC’s listed PBE goals.

To demonstrate Good Faith Effort, list all MBE firms contacted.

Name and Address	Contact Person and Tel #	Contact Date	Type of Work/Materials	Price Quoted	Reason(s) for Not Accepting

END OF SECTION

**AGREEMENT FORM BETWEEN
OWNER AND CONTRACTOR**

A draft of AIA Document A105-2017, modified, follows this page.

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DRAFT AIA® Document A105™ – 2017

Standard Short Form of Agreement Between Owner and Contractor

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)

«Ohio History Connection »« »
«800 E. 17th Avenue »
«Columbus, OH 43211 »

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

«»
«»
«»
«»

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

«»
«»
«»

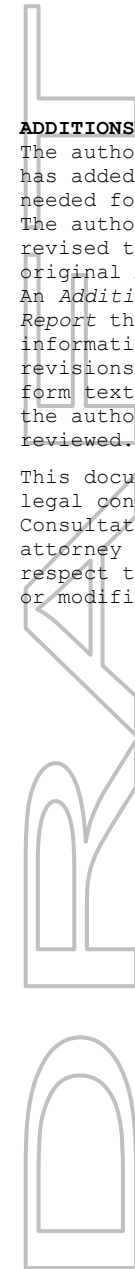
The Architect:
(Name, legal status, address and other information)

«Fred R. Smith »« »
«Ohio History Connection »
«800 E. 17th Avenue »
«Columbus, OH 43211 »

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.

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



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ARTICLE 1 THE CONTRACT DOCUMENTS

§ 1.1 The Contractor shall complete the Work described in the Contract Documents for the Project. The Contract Documents consist of:

- .1 this Agreement signed by the Owner and Contractor;
- .2 the drawings and specifications prepared by the Architect, dated «», and enumerated as follows:

Drawings:

Number	Title	Date
« <input type="text"/> »	<input type="text"/>	<input type="text"/>

Specifications:

Section	Title	Pages
« <input type="text"/> »	<input type="text"/>	<input type="text"/>

- .3 addenda prepared by the Architect as follows:

Number	Date	Pages
« <input type="text"/> »	<input type="text"/>	<input type="text"/>

- .4 written orders for changes in the Work, pursuant to Article 10, issued after execution of this Agreement; and
- .5 other documents, if any, identified as follows:

«Section 00 73 00 Supplementary Conditions »

ARTICLE 2 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 2.1 The Contract Time is the number of calendar days available to the Contractor to substantially complete the Work.

§ 2.2 Date of Commencement:

The Date of Commencement shall be established in a notice to proceed issued by the Architect, as authorized by the Owner or as provided in the Supplementary Conditions and is the day the Contractor is authorized to begin its activities under this Contract.

§ 2.3 Substantial Completion and Final Completion:

§ 2.3.1 The initial date of Substantial Completion shall be the named date or the last day of the period to achieve Substantial Completion as established in the Supplementary Conditions, unless and until modified as provided in Article 10. The Contractor shall schedule and prosecute the Work regularly and diligently at a rate of progress to achieve a Certificate of Substantial Completion on or before the approved date of Substantial Completion.

« »

§ 2.3.2 The initial date of Final Completion shall be the named date or the last day of the period to achieve Final Completion as established in the Supplementary Conditions, unless and until modified as provided in Article 10. The Contractor shall schedule and prosecute the Work regularly and diligently at a rate of progress to achieve Final Completion on or before the approved date of Final Completion.

« »

ARTICLE 3 CONTRACT SUM

§ 3.1 The Contract Sum shall include all items and services necessary for the proper execution and completion of the Work. Subject to additions and deductions in accordance with Article 10, the Contract Sum is:

« » (\$ « »)

§ 3.2 For purposes of payment, the Contract Sum includes the following values related to portions of the Work: *(Itemize the Contract Sum among the major portions of the Work.)*

Portion of the Work

Value

« »

§ 3.3 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and hereby accepted by the Owner: *(Identify the accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)*

« »

§ 3.4 Allowances, if any, included in the Contract Sum are as follows: *(Identify each allowance.)*

Item	Price
<< >>	

§ 3.5 Unit prices, if any, are as follows:
(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)
<< >>		

ARTICLE 4 PAYMENTS

§ 4.1 Based on Contractor’s Applications for Payment certified by the Architect, the Owner shall pay the Contractor, in accordance with Article 12, as follows:

(Insert below timing for payments and provisions for withholding retainage, if any.)

<< >>

§ 4.2 Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate below, or in the absence thereof, at the legal rate prevailing at the place of the Project.
(Insert rate of interest agreed upon, if any.)

<<0.00 >> % << zero >>

§ 4.3 RETAINAGE

§ 4.3.1 When the major portion of the Work is complete or is in use by the Owner (as determined by the Architect and approved by the Owner) the Contractor may request a reduction in the amount retained as determined under §12.2.1.4.

§ 4.3.2 Upon written consent of the Contractor’s surety, and the Contractor’s submittal of lien releases from the Contractor’s subcontractors and material suppliers for work performed to date and for materials ordered to date, the Owner may at its sole discretion, reduce the amount retained.

§ 4.3.3 Any reduction or release of retained funds shall not be a waiver of the Owner’s right to retain funds relative to future payments to the Contractor, or any other right or remedy the Owner has under the Contract Documents at law or in equity.

ARTICLE 5 INSURANCE AND BONDS

§ 5.1 The Contractor shall provide Contractor’s general liability and other insurance as follows:

(Insert specific insurance requirements and limits.)

§ 5.2 WORKER’S COMPENSATION

§ 5.2.1 All Contractors shall procure and maintain during the life of the Contract, and provide evidence of Worker’s Compensation Insurance as required by the State of Ohio for all employees to be engaged on the project prior to commencing any work on the project.

§ 5.2.2 The Contractor shall require its subcontractors to procure and maintain during the life of the Contract, Worker’s Compensation Insurance as required by the State of Ohio for all employees to be engaged on the project and shall require its subcontractors to provide evidence of such coverage to the Contractor before commencing the subcontractor work on the project.

§ 5.3 INSURANCE

§ 5.3.1 The Contractor shall not commence work under this Agreement until the Contractor has obtained all the insurance required hereunder and such insurance has been approved by the Ohio Historical Society. The Contractor shall not allow any subcontractor to commence work on a subcontract until all similar insurance required of the subcontractor(s) has been so obtained and approved. Approval of the insurance by the Ohio Historical Society shall not relieve or decrease the liability of the Contractor hereunder.

- .1 The Contractor shall provide acceptable evidence of the required insurance which shall also include the Ohio Historical Society project number and name and the insurance agent company name, address, and telephone number.

§ 5.4 CONTRACTOR'S LIABILITY INSURANCE

§ 5.4.1 The Contractor shall acquire and maintain during the term of the Contract, Bodily Injury and Property Damage Liability Insurance under an acceptable Comprehensive General/Automobile Liability Policy which shall provide and include coverage on all Contractor's Operations, Contractor's Protective (Sublet) Liability, Contractual Liability, Completed Operations Liability, Owned Automobiles and Non-Owned and Hired Automobiles.

- .1 The Contractor shall provide and shall require its Subcontractors to provide insurance required by this section that names the Ohio Historical Society as an additional insured.

§ 5.4.2 The Contractor shall acquire and maintain Property Damage Liability Insurance in an amount of not less than One Million (\$1,000,000) Dollars per occurrence with General Liability extended to provide "Broad Form Property Liability" and in the amount of not less than Three Million (\$3,000,000) Dollars aggregate for damage on account of all occurrences.

§ 5.4.3 Provide Bodily Injury Insurance limits for an amount of not less than One Million (\$1,000,000) Dollars for injuries, including wrongful death to any one person, and subject to the same limit for each person, in an amount of not less than Three Million (\$3,000,000) Dollars on the account of any one occurrence.

§ 5.4.4 Any combination of underlying Comprehensive General/Automobile Liability coverage with Umbrella/Excess Liability coverage which provides not less than Three Million (\$3,000,000) Dollars Single Limit Bodily Injury and Property Liability Insurance for the Contractor will also be acceptable.

§ 5.5 CONTRACTOR'S PROPERTY INSURANCE

§ 5.5.1 The Contractor shall maintain Property Insurance (e.g., Builder's Risk, Installation Floater) to protect itself and the Ohio Historical Society from loss incurred by fire, lightning, extended coverage hazards, vandalism, malicious mischief, and other casualties in the full amount of the Contract and such insurance shall cover all labor and materials connected with the work, including materials delivered to the site and not yet installed in the project. The insurance shall specifically name coverage for loss incurred due to theft. Prior to commencement of any work under this Contract, for each type of insurance coverage under this Section 5.5.1, the Contractor shall furnish to the Owner one (1) original evidence of coverage signed by an authorized representative of the insurer.

§ 5.6 (NOT USED)

§ 5.7 INDEMNIFICATION AND SUBROGATION

§ 5.7.1 The maintaining of such insurance as outlined herein shall in no way constitute a waiver of legal liability for damage to any adjoining buildings or their contents or the work and property of others on the site beyond the limits of insurance thus maintained. The Contractor shall indemnify and hold the Ohio Historical Society, its volunteers, employees, and officers free and harmless from any injury and damage resulting from the negligent or faulty performance of the Contract by the Contractor or subcontractors.

§ 5.7.2 The Contractor shall provide and shall require its Subcontractors to provide insurance under § 5.4 Contractor's Liability Insurance and § 5.5 Contractor's Property Insurance naming the Ohio Historical Society as an additional insured.

§ 5.7.3 The Owner, Contractor, and its subcontractors understand and agree, by entering into this Agreement, to waive subrogation.

§ 5.8 BONDS

§ 5.8.1 The Contractor shall maintain the Contract Bond submitted with the Contractor's Bid and accepted by the Owner.

§ 5.8.2 In the situation in which the Contractor submitted certified funds as its Bid Bond with its Bid, the Contractor shall acquire and maintain a Contract Bond acceptable to the Owner as a condition precedent to the execution of this Agreement.

ARTICLE 6 GENERAL PROVISIONS

§ 6.1 The Contract

The Contract represents the entire and integrated agreement between the parties and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a written modification in accordance with Article 10.

§ 6.2 The Work

The term "Work" means the construction and services required by the Contract Documents, and includes all other labor, materials, equipment, and services provided, or to be provided, by the Contractor to fulfill the Contractor's obligations.

§ 6.3 Intent

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.

§ 6.4 Ownership and Use of Architect's Drawings, Specifications and Other Documents

Documents prepared by the Architect are instruments of the Architect's service for use solely with respect to this Project. The Architect shall retain all common law, statutory, and other reserved rights, including the copyright. The Contractor, subcontractors, sub-subcontractors, and suppliers are authorized to use and reproduce the instruments of service solely and exclusively for execution of the Work. The instruments of service may not be used for other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Architect.

§ 6.5 Electronic Notice

Written notice under this Agreement may be given by one party to the other by email as set forth below.
(Insert requirements for delivering written notice by email 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.)

<< >>

ARTICLE 7 OWNER

§ 7.1 Information and Services Required of the Owner

§ 7.1.1 If requested by the Contractor, the Owner shall furnish all necessary surveys and a legal description of the site.

§ 7.1.2 Except for permits and fees under Section 8.7.1 that are the responsibility of the Contractor, the Owner shall obtain and pay for other necessary approvals, easements, assessments, and charges.

§ 7.1.3 Prior to commencement of the Work, at the written request of 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.

§ 7.2 Owner's Right to Stop the Work

If the Contractor fails to correct Work which is not in accordance with the Contract Documents, the Owner may direct the Contractor in writing to stop the Work until the correction is made.

§ 7.3 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 seven day period after receipt of written 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, correct such deficiencies. In such case, the Architect may withhold or nullify a Certificate for Payment in whole or in part,

to the extent reasonably necessary to reimburse the Owner for the cost of correction, provided the actions of the Owner and amounts charged to the Contractor were approved by the Architect.

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

§ 7.4.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project.

§ 7.4.2 The Contractor shall coordinate and cooperate with the Owner's own forces and separate contractors employed by the Owner.

§ 7.4.3 Costs caused by delays or by improperly timed activities or defective construction shall be borne by the party responsible therefor.

ARTICLE 8 CONTRACTOR

§ 8.1 Review of Contract Documents and Field Conditions by Contractor

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

§ 8.1.2 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Owner. Before commencing activities, the Contractor shall (1) take field measurements and verify field conditions; (2) carefully compare this and other information known to the Contractor with the Contract Documents; and (3) promptly report errors, inconsistencies, or omissions discovered to the Architect.

§ 8.2 Contractor's Construction Schedule

The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work.

§ 8.3 Supervision and Construction Procedures

§ 8.3.1 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.

§ 8.3.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner, through the Architect, the names of subcontractors or suppliers for each portion of the Work. The Contractor shall not contract with any subcontractor or supplier to whom the Owner or Architect have made a timely and reasonable objection.

§ 8.4 Labor and Materials

§ 8.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work.

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

§ 8.5 Warranty

The Contractor warrants to the Owner and Architect that: (1) materials and equipment furnished under the Contract will be new and of good quality unless otherwise required or permitted by the Contract Documents; (2) the Work will be free from defects not inherent in the quality required or permitted; and (3) the Work will conform to the requirements of the Contract Documents. Any material or equipment 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 12.5.

§ 8.6 Taxes

The Contractor shall pay sales, consumer, use, and similar taxes that are legally required when the Contract is executed.

§ 8.6.2 This project is exempt from Ohio sales and use tax. Prior to making the initial purchase under this Contract, the Contractor shall request and receive from the Owner a valid "State of Ohio Department of Taxation Sales and Use Tax Blanket Exemption Certificate," and shall use the Owner's exemption number when purchasing project-relevant goods and materials.

§ 8.7 Permits, Fees and Notices

§ 8.7.1 The Owner shall obtain and pay for the Certificate of Plan Approval issued by the Ohio Department of Commerce, Division of Industrial Compliance.

§ 8.7.2 The Contractor shall schedule and coordinate all life safety inspections required by the State of Ohio Fire Marshal's Office as necessary.

- .1 The Owner shall pay the associated initial inspection fees.
- .2 The Contractor shall pay for all associated governmental re-inspection fees.

§ 8.7.3 The Contractor shall obtain and pay for all other permits and governmental fees, licenses, and inspections necessary for proper execution and completion of the work.

§ 8.7.4 The Contractor shall schedule and coordinate all inspections required by applicable authorities.

§ 8.7.5 The Contractor shall comply with and give notices required by agencies having jurisdiction over the Work. 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 full responsibility for such Work and shall bear the attributable costs. The Contractor shall promptly notify the Architect in writing of any known inconsistencies in the Contract Documents with such governmental laws, rules, and regulations.

§ 8.8 Submittals

The Contractor shall promptly review, approve in writing, and submit to the Architect shop drawings, product data, samples, and similar submittals required by the Contract Documents. Shop drawings, product data, samples, and similar submittals are not Contract Documents.

§ 8.9 Use of Site

The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits, the Contract Documents, and the Owner.

§ 8.10 Cutting and Patching

The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

§ 8.11 Cleaning Up

The Contractor shall keep the premises and surrounding area free from accumulation of debris and trash related to the Work. At the completion of the Work, the Contractor shall remove its tools, construction equipment, machinery, and surplus material; and shall properly dispose of waste materials and timely and fully demobilize from the project site.

§ 8.12 Indemnification

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.

ARTICLE 9 ARCHITECT

§ 9.1 The Architect will provide administration of the Contract as described in the Contract Documents. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 9.2 The Architect will visit the site at intervals appropriate to the stage of construction to become generally familiar with the progress and quality of the Work.

§ 9.3 The Architect will not have control over or charge of, and will not be responsible for, construction means, methods, techniques, sequences, or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's responsibility. The Architect will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents.

§ 9.4 Based on the Architect's observations and evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor.

§ 9.5 The Architect has authority to reject Work that does not conform to the Contract Documents.

§ 9.6 The Architect will promptly review and approve or take appropriate action upon Contractor's submittals, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 9.7 On written request from either the Owner or Contractor, the Architect will promptly interpret and decide matters concerning performance under, and requirements of, the Contract Documents.

§ 9.8 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.

§ 9.9 The Architect's duties, responsibilities, and limits of authority as described in the Contract Documents shall not be changed without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

ARTICLE 10 CHANGES IN THE WORK

§ 10.1 The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract, consisting of additions, deletions or other revisions, and the Contract Sum and Contract Time shall be adjusted accordingly, in writing. If the Owner and Contractor cannot agree to a change in the Contract Sum, the Owner shall pay the Contractor its actual cost plus reasonable overhead and profit.

§ 10.2 The Architect may authorize or 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. Such authorization or order shall be in writing and shall be binding on the Owner and Contractor. The Contractor shall proceed with such minor changes promptly.

§ 10.3 If concealed or unknown physical conditions are encountered at the site that differ materially from those indicated in the Contract Documents or from those conditions ordinarily found to exist, the Contract Sum and Contract Time shall be subject to equitable adjustment.

ARTICLE 11 TIME AND LIQUIDATED DAMAGES

§ 11.1 Time limits stated in the Contract Documents are of the essence of the Contract.

§ 11.2 If the Contractor is delayed at any time in progress of the Work by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, or other causes beyond the Contractor's control, the Contract Time shall be subject to equitable adjustment.

§ 11.3 Costs caused by delays or by improperly timed activities or defective construction shall be borne by the responsible party.

§ 11.4 If the Contractor is delayed at any time in progress of the Work by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be subject to equitable adjustment.

§ 11.5 The Contractor shall prosecute the Work regularly and diligently at a rate of progress that ensures the issuance of a Certificate of Substantial Completion and a Certificate of Final Completion on or before the approved dates as provided in §2.1 and §2.3.

§ 11.6 The Owner will suffer financial loss if the Work is not timely completed. Time is of the essence for completion of the Work. Contractor and its surety shall be liable for and pay the Owner liquidated damages for each day its work exceeds the approved dates for Substantial Completion and Final Completion. Liquidated damages may be deducted by the Owner from any payment due or to become due to the Contractor. The rate of liquidated damages shall be as indicated in the Supplementary Conditions.

§ 11.6.1 It is agreed that the rate of liquidated damages indicated in the Supplementary Conditions is reasonable and that the damages the Owner would sustain are difficult to determine. The foregoing provisions for liquidated damages, shall in no way act as a waiver of the Owner's rights to any other remedy of law, in equity or under the Contract Documents.

§ 11.7 The items listed in the Architect's Certificate of Substantial Completion to be completed or corrected, if any, shall be corrected and completed by the Contractor on or before the approved date of Final Completion.

§ 11.8 Wherever provisions of any Section of the Contract Documents conflict with agreements or regulations in force among members of trade associations, unions, or councils which regulate or distinguish what work shall or shall not be included in the construction activity of any particular trade, the Contractor shall make necessary arrangements to reconcile such conflict without delay, recourse, damage, or cost to the Owner or Architect.

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

§ 11.10 Contractor's written claims for extension of time shall be submitted within 10 days of the issues or circumstances that caused or will cause the Contractor's written claim. Such claims shall be accompanied by detailed dates, correspondence, notices, and other data which provides proof of the events which are the basis for the claim.

§ 11.11 Delays due to tardy shop drawing submittal, tardy material ordering, or shipment, or other delays caused by a supplier of a Subcontractor of the Contractor shall not be deemed valid causes for extension of time, as the scheduling and control of suppliers and Subcontractors is a part of the Contractor's responsibility.

§ 11.12 Time extensions will be granted for legitimate cause on an individual basis. 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, the agreed-upon extension of time required because of the change in the Work shall be a part of the Change Order. Permitting the Contractor to continue and finish the Work after the dates to which the time of completion may have been extended, shall in no way operate as a waiver on the part of the Owner of its rights under the contract.

ARTICLE 12 PAYMENTS AND COMPLETION

§ 12.1 Contract Sum

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

§ 12.2 Applications for Payment

§ 12.2.1 The Contractor shall submit to the Architect an itemized Application for Payment for Work completed in accordance with the values stated in the Agreement. Such Application shall be supported by data substantiating the Contractor's right to payment as the Owner or Architect may reasonably require. 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 stored, and protected from damage, off the site at a location agreed upon in writing.

.1 Application and Submittal Period. The period covered by each Application for Payment shall be one calendar month ending on the last day of the month. The Owner will accept an application on the last three (3) work days of the period covered by an Application for Payment and on the first work day of the month following the period covered by an Application for Payment. The Owner will accept and process applications submitted later, however, payment will be delayed as provided below.

.2 Application Form. An application for payment shall be provided in a form mutually accepted by both parties which shall include and is not limited to the following information. *G702-Application and Certification for Payment* published by the American Institute of Architect and *Form FI40-01 Contractor Payment Request* published by the State Architect's Office of Ohio are acceptable forms.

- i. the project name and OHS project number
- ii. the start and end dates of the period covered by the application
- iii. original contract amount; the amount of each change authorized by the Owner to date; the contract amount to date;
- vi. a schedule of values in sufficient detail to identify the cost of materials and labor for the various types and major components of the work;
- vii. a percentage of completion for each line item in the schedule of values;
- viii. an area for retainage and an area for Liquidated Damages.
- ix. Contractor's certification that to its knowledge the information on the application is true and accurate;
- x. Architect's certification that based on its on-site observations, knowledge, information, and beliefs the information on the application is true and accurate; and,
- xi. approval and signature block for the Owner.

.3 Progress Review. The Contractor shall establish a schedule with the Architect payment application review meetings that allow sufficient time for the Contractor and Architect to process an application for payment and have it delivered to the Owner to meet the schedule established in §4.1.1. Prior to the end of each period, the Parties shall review a draft of the Application and make adjustments as deemed appropriate. The Contractor shall make the agreed adjustments and submit the adjusted application, including certification to the Architect for its review and certification and subsequent forwarding to the Owner. On each Application for Payment, the Contractor shall show the percentage of completion for each line item in the schedule of values as of the end of the period covered by the Application for Payment.

.4 Amount of Progress Payment. The amount of the progress payment shall be the percentage of the completion of the work at the end of the period times the contract price less ten percent for retainage and less the amounts paid for prior progress payments.

.5 Payment – for requested payments of less than \$10,000.00. the Application Period in proper form and certified by the Architect for payment, the Owner shall make payment of undisputed amounts within 30 days of the first work day of the month following the period covered by the application and for an application submitted after the Application Period, the Owner shall make payment of undisputed amounts within 60 days of the first work day of the month following the period covered by the application.

.6 Payment – for requested payments of \$10,000.00 and more. Provided an application is submitted within the Application Period in proper form and certified by the Architect for payment, the Owner shall make payment of undisputed amounts within 60 days of the first day of the month following the period covered by the application and for an application submitted after the Application Period, the Owner shall make payment of undisputed amounts within 90 days of the first work day of the month following the period

covered by the application.

§ 12.2.3 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, however, such transfer of title shall not reduce the Contractor's and surety(ies) obligations for such Work until the Work achieves Final Completion. 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 other encumbrances adverse to the Owner's interests.

§ 12.3 CERTIFICATES FOR PAYMENT

After receipt of the Contractor's Application for Payment, the Architect will timely either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part.

§ 12.4 PROGRESS PAYMENTS

§ 12.4.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner provided in article 12.2.

§ 12.4.2 The Contractor shall promptly pay each subcontractor and supplier, upon receipt of payment from the Owner, an amount determined in accordance with the terms of the applicable subcontracts and purchase orders.

§ 12.4.3 Neither the Owner nor the Architect shall have responsibility for payments to a subcontractor or supplier.

§ 12.4.4 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 requirements of the Contract Documents.

§ 12.5 SUBSTANTIAL COMPLETION

§ 12.5.1 A condition of determining a Substantial Completion shall be the Contractor's correction of all punch list items on the Architect's punch list and the Contractor's total demobilization from the physical site. Preparation of project closeout requirements shall occur at a location of the Contractor's choosing, other than the project site, in the period, if any, between Substantial Completion and Final Completion.

§ 12.5.2 When the Contractor notifies the Architect that the Work or designated portion thereof is substantially complete, the Architect will make an inspection to determine whether the Work is substantially complete. When the Architect determines that the Work is substantially complete the Architect shall prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish the responsibilities of the Owner and Contractor, and shall 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.

.1 Items remaining on the punch list shall be addressed in accordance with §11.7.

§ 12.6 FINAL COMPLETION AND FINAL PAYMENT

§ 12.6.1 Upon receipt of all project closeout submittals as required by the Contract Documents (e.g., Operating & Maintenance Manuals, as-built documents, permits, warranties) and the final Application for Payment, the Architect will inspect the Work. When the Architect finds the Work acceptable and the contract fully performed, the Architect will promptly issue a final Certificate for Payment.

§ 12.6.2 Final payment shall not become due until the Contractor submits to the Architect releases and waivers of liens, and data establishing payment or satisfaction of obligations, such as receipts, claims, security interests or encumbrances arising out of the Contract and the Contractor's final certified Application for Payment in proper form.

§ 12.6.3 Upon receipt of a final Certificate of Application for Payment in proper form, the Owner shall timely review and approve payment of undisputed amounts. Owner shall make final payment only after the Contractor has fully performed the Contract, except its obligation to timely and properly provide Warranty Work. The Owner's approval and final outstanding balance of the Contract Sum, as provided herein, shall constitute Final Completion.

§ 12.6.4 Acceptance of final payment by the Contractor, a subcontractor, or material 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.

§ 12.6.5 Acceptance of final payment does not relieve the Contractor, subcontractor, or material supplier from their respective responsibilities to honor all warranties and guarantees.

ARTICLE 13 PROTECTION OF PERSONS AND PROPERTY

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs, including all those required by law in connection with performance of the Contract. The Contractor shall take reasonable precautions to prevent damage, injury, or loss to employees on the Work and other persons who may be affected thereby, the Work and materials and equipment to be incorporated therein, and other property at the site or adjacent thereto. The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, or by anyone for whose acts the Contractor may be liable.

ARTICLE 14 CORRECTION OF WORK

§ 14.1 The Contractor shall promptly correct Work rejected by the Architect as failing to conform to the requirements of the Contract Documents. The Contractor shall bear the cost of correcting such rejected Work, including the costs of uncovering, replacement, and additional testing.

§ 14.2 In addition to the Contractor's other obligations including warranties under the Contract, the Contractor shall, for a period of one year after Substantial Completion, correct work not conforming to the requirements of the Contract Documents promptly and timely after receiving notice of such work.

§ 14.3 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Section 7.3.

ARTICLE 15 MISCELLANEOUS PROVISIONS

§ 15.1 Assignment of Contract

Neither party to the Contract shall assign the Contract as a whole without written consent of the other.

§ 15.2 Tests and Inspections

§ 15.2.1 At the appropriate times, the Contractor shall arrange and bear cost of tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities.

§ 15.2.2 If the Architect requires additional testing, the Contractor shall perform those tests.

§ 15.2.3 The Owner shall bear cost of tests, inspections, or approvals that do not become requirements until after the Contract is executed. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 15.3 Governing Law

The Contract shall be governed by the law of the State of Ohio.

§ 15.4 CLAIMS AND DISPUTES

§ 15.4.1 Claims, disputes and other matters in question arising out of or relating to this contract, including those alleging an error or omission by the Architect, shall be referred initially to the Architect for decision. Such matters, except those related to aesthetic effect and those waived as provided by this Contract, shall, after initial decision by

§15.4.2 Any legal action arising out of or related to this contract shall be brought in the Common Pleas Court of Franklin County, Ohio, unless the amount in dispute is less than \$15,000.00, in which case, the action shall be brought in the Franklin County Municipal Court located in Franklin County, Ohio.

§ 15.4.3 In any legal action arising out of or related to this contract, each of the parties agrees to waive the right to trial by jury.

§15.4.4 In any legal action arising out of or related to this contract either party may demand that the matter be submitted to mediation in which case the matter shall be mediated by a mediator agreed upon by the parties, and in the event the parties can not agree upon a mediator, by a mediator appointed by the judge to whom the case is assigned. Mediation shall be initiated by the serving of a demand for mediation on the other party with the proposed name of a mediator.

Within seven days after receipt of such demand, the party receiving the demand shall notify the party serving the demand whether it agrees to the mediator proposed, and if not, the name of a mediator proposed by such party. The party making it the demand for mediation shall notify the other party within seven days whether the party making the demand agrees to the proposed mediator. If the parties do not agree upon a mediator, either party may request the Court to appoint a mediator who may be a magistrate of such Court. If a demand for mediation is made all discovery proceedings in the legal action shall be stayed and no motions shall be filed until the mediation is completed. The time and place of the mediation conference shall be set by the mediator. No statements made by a party during the mediation shall be used in evidence at the trial of the action. The expense of the mediator, if any, shall be divided equally between the parties.

§ 15.5 CLAIMS FOR CONSEQUENTIAL DAMAGES

§ 15.5.1 The Contractor and Owner waive claims against each other for consequential damages arising out of or relating to the 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, for loss of profit except anticipated profit arising directly from the Work, and for any amount which the Contractor is required to reimburse the surety by reason of expenses incurred by the surety related to correction or completion of the Work.

§ 15.5.2 This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 16. Nothing contained in this Section shall be deemed to preclude an award of liquidated direct damages, when applicable, in accordance with the requirements of the Contract Documents.

ARTICLE 16 TERMINATION OF THE CONTRACT

§ 16.1 Termination by the Contractor

§ 16.1.1 If the Architect fails to certify payment as provided in §12.3 through no fault of the Contractor, or if the Owner fails to make payment as provided in §12.4.1, the Contractor may, upon seven additional days written notice to the Owner and the Architect, terminate the Contract in which case the Contractor shall be entitled to be paid for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery ordered in reliance upon the contract, and for reasonable overhead and profit on the remainder of the Work that was not completed.

§ 16.1.2 Owner payment of undisputed amounts to the Contractor within seven (7) additional days shall render null and void the Contractor's right to terminate the Contract as provided in §16.1.1 and the Contractor shall continue to faithfully and diligently execute the Work under this Contract and shall not be entitled to additional payment for claims of loss with respect to materials, equipment, tools, and construction equipment and machinery ordered nor for additional overhead and profit.

§ 16.2 Termination by the Owner for Cause

§ 16.2.1 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 for materials or labor in accordance with the respective agreements between the Contractor and the subcontractors;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 is otherwise guilty of substantial breach of a provision of the Contract Documents.

§ 16.2.2 When any of the above reasons exist, the Owner, after consultation with the Architect, 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' written notice, terminate employment of the Contractor and may

- .1 take possession of the site and of all materials thereon owned by the Contractor, and
- .2 finish the Work by whatever reasonable method the Owner may deem expedient.

§ 16.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 16.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 16.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the Owner. This obligation for payment shall survive termination of the Contract.

§ 16.3 Termination by the Owner for Convenience

The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause. The Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

§ 16.4 Under no circumstances shall the Owner be liable to the Contractor and the Contractor's Surety, if the Surety takes over the Contract, for more than the contract price.

ARTICLE 17 OTHER TERMS AND CONDITIONS

(Insert any other terms or conditions below.)

« »

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

(If required by law, insert cancellation period, disclosures or other warning statements above the signatures.)

« »

« »

OWNER *(Signature)*

«Lox A. Logan, Executive Director
Ohio History Connection
800 E. 17th Avenue
Columbus, OH 43211 »« »

(Printed name and title)

« »

CONTRACTOR *(Signature)*

« »« »

(Printed name and title)

LICENSE NO.:
JURISDICTION:

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SECTION 00 73 00 SUPPLEMENTARY CONDITIONS

PART 1 – GENERAL

1.1 SUMMARY

- A. These Supplementary Conditions are a part of and are attached to the Contract Documents as provided in the American Institute of Architects (AIA) Document *A105-2017 Standard Form of Agreement Between Owner and Contractor for a Small or Commercial Project* for this project.
- B. These Supplementary Conditions modify the AIA document(s) as originally published by the AIA and listed above for this project.

PART 2 – CONTRACT MODIFICATIONS

2.1 REFER TO §2.1 CONTRACT TIME

- A. The Contract Time extends to the Date of Final Completion as provided below.

2.2 REFER TO §2.3 SUBSTANTIAL AND FINAL COMPLETION

- A. The Date of Commencement shall be no more than 14 days following filing of Notice to Proceed March 1, 2023.
- B. Substantial Completion shall occur no more than 150 days following Date of Commencement.
- C. Final Completion shall occur no more than 165 days following Date of Commencement.

2.3 REFER TO §10.1 CHANGES IN THE WORK

- A. § 10.1.1 The limit for the combined overhead and profit included in the total cost to the Owner shall be based on the following schedule:
 - 1. For the Contractor, for Work performed by the Contractor's own forces, fifteen percent (15%) of the cost.
 - 2. For the Contractor, for Work performed by the Contractor's Subcontractor, maximum of five percent (5%) of the amount due between Prime Contractor and Subcontractor. For the Subcontractor, for Work performed by the Subcontractor's own forces, ten percent (10%) of the cost.
 - 3. Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.7.
 - 4. In order to facilitate checking of quotations for extras and 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 Subcontracts. Labor and material shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also.

5. Overhead and profit shall include, but not be limited to, the following:
 - a. home office expense;
 - b. field office expense;
 - c. supervision;
 - d. project management & estimation; and
 - e. small tools & equipment

2.4 REFER TO §11.5 RATES OF LIQUIDATED DAMAGES

- A. The following rates for Liquidated Damages apply to this Contract:
 1. Substantial Completion date exceeded: \$750.00/ day.
 2. Final Completion date exceeded: \$750.00/ day.

PART 3 – PLANS AND SPECIFICATION MODIFICATIONS

- 3.1 A. Not applicable

END OF SECTION

SECTION 00 73 46 – PREVAILING WAGE DETERMINATION AND RATES

OHC Project No. CP 2140
Harriet Beecher Stowe House
Interior Restoration

PART 1 – GENERAL

1.1 SUMMARY

- A. The Prevailing Rates of Wages and required forms may be accessed through the Ohio Department of Commerce website:

<https://com.ohio.gov/divisions-and-programs/industrial-compliance/wage-and-hour/guides-and-resources/bid-packet-preparation>

- B. The following wage rate information shall be furnished to the prevailing wage coordinator as designated by the owner.
 - 1. Every contractor and/or subcontractor as soon as he begins work under this contract shall furnish to the prevailing wage coordinator, a schedule of dates during the life of the contract for which he will pay wage to employees of the project. He shall also deliver to the prevailing wage coordinator monthly two (2) certified copies of his payroll for the project.
 - 2. Each report (monthly) shall state the period covered and exhibit for each employee paid on the project, his name, current address, social security number, number of hours worked each day on the project during the reporting period, the total hours each week on the project as well as the total work on other projects, his hourly rate, his job classification, fringe payment, all deductions from his wages and net pay.
 - 3. Each report shall also have certification executed by the contractor, subcontractor, or duly appointed agent thereof. It shall recite that the payroll is correct and complete and that the rates shown are not less than those required by the contract. It shall also state the name of the union or plan to whom the withheld or unpaid fringes are to be paid. The first report shall also list each fringe and state if it is paid as cash to the employee or to named plan.
 - 4. Upon final completion and prior to final payment, the contractor shall execute, deliver, and require its subcontractors to execute and deliver to the prevailing wage coordinator an affidavit stating that the contractor/subcontractor has fully complied with Section 4115.03 to 4115.16 Ohio Revised Code. The contract sum will not be increased because of increases in the prevailing wages or wage rates.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION

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SECTION 01 11 00 SUMMARY OF WORK

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. Work covered by the Contract Documents.
 - 2. Type of the Contract.
 - 3. Use of premises.
 - 4. Owner's occupancy requirements.
 - 5. Work restrictions.
 - 6. Specification formats and conventions.
 - 7. Miscellaneous Provisions.
- B. Related Sections include the following:
 - 1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Harriet Beecher Stowe House
 - 1. Project Location: 2950 Gilbert Ave, Cincinnati OH 45206
- B. Owner: Ohio History Connection, 800 E. 17th Avenue, Columbus, OH 43211
- C. Architect of Record: Fred R. Smith, Ohio History Connection, 800 E. 17th Avenue Columbus, OH 43211
- D. The Work consists of the following:
 - 1. Selective demolition of woodwork, mantels, and moldings. Removal of stairway.
 - 2. New reproduction stairway using some historic moldings and banisters and replication of missing pieces.
 - 3. Restoration and installation of (6) historic mantels.
 - 4. Restoration of sitting room with historic and replication moldings.

1.4 TYPE OF CONTRACT

- A. Project will be constructed under a single prime contract.

1.5 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.
- B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine constructions operations to areas indicated.
 - 2. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public starting August 1, 2023.
 - 3. Driveways and Entrances: Keep driveways, 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.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.6 OWNER'S OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy site existing buildings on the property full time, starting August 1, 2023. 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 authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
 - 3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.7 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 8:00 a.m. to 5:00 p.m., Monday through Friday, except otherwise indicated.
 - 1. Weekend Hours: As allowed by authorities having jurisdiction.
 - 2. Early Morning Hours: As allowed by authorities having jurisdiction

- B. Existing Utility Interruptions: 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 Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-division format and CSI/CSC's "MasterFormat" numbering system.
 - 1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 - 2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

- B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. 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.

1.9 MISCELLANEOUS PROVISIONS

- A. Permits:

1. A Building Permit will be obtained and paid for by Owner through the Architect. Final permit may be contingent upon submission of some contractor submittals.
- B. All other permits, fees, licenses and inspections are to be obtained and paid for by contractor performing the work.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION

SECTION 01 23 00 ALTERNATES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Instructions to Bidders, Form of Agreement between Owner and Contractor, and Supplemental General Conditions in their entirety are a part of this section.

1.2 DESCRIPTION

- A. An Alternate is a potential change of any kind in the project and stated on the Proposal Form that may be added to or deducted from the Base Bid amount, at the Owner's sole discretion.
- B. When accepted, an Alternate shall be a part of the Contract.
- C. When accepted, the Contractor shall provide all elements of an Alternate (e.g., labor, materials, overhead, profit, products, materials, equipment, systems, installation) described in the Contract Documents and as necessary for a complete installation.
 - 1. The cost or credit for each Alternate is the net addition or deduction from the Contract Sum to incorporate the alternate into the Work. No other adjustments are made to the Contract Sum.
- D. An Alternate price shall include all elements and costs to provide the Alternate as allowed by the Contract.
- E. An Alternate may be incorporated into the Project at the same price indicated in the Contractor's Bid for 90 days after the Contract date. An Alternate may be accepted after 90 days after the Contract date and may be subject to negotiation.

1.3 PROCEDURES

- A. Coordinate, modify or adjust affected adjacent work as necessary due to incorporating an Alternate any work affected by any accepted Alternate.
- B. Fully integrate and complete any accepted Alternate(s) into the Project.
- C. Notification: Immediately following award of the Contract, Contractor shall notify each party involved, in writing, of the status of each Alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration.
- D. Execute accepted Alternates under the same Contract requirements as other work of the Contract.
- E. Incorporate accepted Alternates into the project schedule and project planning in a manner that causes no delay to other trades or to the timely completion of the Project.

1.4 SCHEDULE OF ALTERNATES

A. ALTERNATE NO. 1 – LANDSCAPING

Description: Bidder shall state the amount to be ADDED TO the Base Bid to provide for the installation of all landscaping, DEDUCTING seeding for grass in planting beds.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION

SECTION 01 26 00 CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. For a project that include one or more Allowances, Division 01, Section 01 21 00 - Allowances shall apply.

1.2 MINOR CHANGES IN THE WORK

- C. The 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", or other form acceptable to the Owner.

1.2 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 or Specifications or both
 - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within the time specified in Proposal Request, submit a Proposal indicating any applicable adjustment to the Contract Sum or Contract Time or both, 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.

- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes 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.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests or other form acceptable to the Architect.

1.3 CHANGE ORDER PROCEDURES

- A. Upon the Owner's approval of a Proposal, the Architect will sign and issue a Change Order for Owner and Contractor signatures.

1.4 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: The Architect may issue a Construction Work Change Directive on AIA Document G714 —Construction Change Directive, or other form acceptable to the Owner, which instructs the Contractor to proceed with a change or changes in the Work, for subsequent inclusion in a Change Order.
 - 1. A Construction Change Directive provides a description of a change or changes in the Work and designates the method to determine any change in the Contract Sum or Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis for the work required by the Construction Change Directive.
 - 1. After completion of the change or changes, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION

SECTION 01 31 19 PROJECT MEETINGS

PART 1 - GENERAL

1.1 INITIAL JOB MEETING

- A. The Contractor will notify all parties concerned of the time and place of the initial job meeting.
- B. The meeting will be conducted by the Owner's Representative. In order to insure an orderly procedure, an agenda for the meeting will be developed using the following format:
 - 1. Review of Previous Minutes
 - 2. Safety Issues
 - 3. Schedule Status
 - 4. Field Work Orders, Change Orders, Construction Directives, and Requests for Information
 - 5. Pay Request
 - 6. Work Progress Since Last Meeting
 - 7. Work Proposed for Next Week
 - 8. Report from Subcontractors
 - 9. Interferences and Conflicts
 - 10. New Business
 - 11. Next Meeting date, time, location
- C. The Architect will prepare and distribute the Meeting Minutes within seven (7) days of the meeting.

1.2 WEEKLY JOB MEETINGS

- A. Unless otherwise directed, job meetings will be held every week and place agreed upon by the Project Architect and the Contractor. Other interested parties may attend when needed, e.g., subcontractors, representatives from suppliers, and consultants.
- B. The meetings will be conducted by the Contractor for the following purposes:
 - 1. Review job progress, quality of Work, and approval and delivery of materials.
 - 2. Identify and resolve problems which impede planned progress.
 - 3. Coordinate the efforts of all concerned so that the project progresses on schedule to on time completion.
 - 4. Maintain a sound working relationship between the Contractor and the Project Architect and a mutual understanding of the project requirements.
 - 5. Maintain sound working procedures.

1.3 PRE-INSTALLATION MEETINGS

- A. Pre-installation meetings will be held to review the specifications, drawings and approved submittals in preparation for start of a particular activity.

1.4 ATTENDANCE

- A. The Contractor or his Representative shall be required to attend all meetings scheduled.
- B. The Contractor's representative shall be a competent supervisor familiar with the work and have authority to act for the Contractor.
- C. If the Contractor's representative fails to attend 2 scheduled meetings without prior approval, the Contractor will be directed to replace the current Contractor's representative. Further incidents of non-attendance by the Contractor's representative, will form the basis for review of the Contractor's responsible bidder status.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 01 31 19

SECTION 01 33 00 SUBMITTAL PROCEDURES

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 administrative and procedural requirements for submittals required for performance of this Work.

1.3 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 1. After award and before date of Commencement, coordinate with the Architect to mutually agree on the submittal schedule and review periods.
 - 2. If an intermediate submittal is necessary, process the same as the initial submittal.
 - 3. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.
- B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on label or title block.
 - 1. Provide a space approximately 4 by 5 inches on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
 - 2. Include the following information on the label for processing and recording action taken:
 - a. Project name
 - b. Date
 - c. Name and address of the Architect
 - d. Name and address of the Contractor
 - e. Name of the manufacturer (if applicable)
 - f. Number and title of appropriate Specification Section
 - g. Drawing number and detail references, as appropriate

- C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Architect using a transmittal form. The Architect will accept submittals only from the Contractor.
 - 1. On the transmittal record relevant information and requested data.
 - 2. On the form or separate sheet, record deviations from Contract Document requirements, including variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

1.4 CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: After award and before date of Commencement, prepare and submit a horizontal bar-chart construction schedule based on critical path logic and indicating weekly or daily activities on a time scale.
- B. Phasing: As appropriate for the project, on the schedule, show how requirements for phased Work by separate Subcontractors and third party Contractors and will affect the sequence of Work.
- C. Work Stages: Indicate important stages of construction for each major portion of the work, including submittal review, testing, and installation, mobilization, demobilization, and major segments of construction.
- D. Area Separation: Provide a separate time bar to identify each major construction area for each portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.
- E. Cost Correlation: For projects over \$200,000 construction value, at the head of the schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of Work performed as of the dates used for preparation of payment requests.
 - 1. Refer to Division 1 Section "Application for Payment" for cost reporting and payment procedures.
- F. Distribution: Upon Architect's approval of the Construction Schedule, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office. For projects with no project meeting room or temporary field office, have copies available at the project site at all times.
- G. Schedule Updating: Revise the schedule after each meeting, event, or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

1.5 SUBMITTAL SCHEDULE

- A. After development and acceptance of the Contractor’s Construction Schedule, prepare a complete schedule of submittals. Submit the Schedule within 10 days of the date required for submittal of the Contractor’s Construction Schedule.
 1. Coordinate Submittal Schedule with the list of subcontractors, Schedule of Values, and the list of products as well as the Contractor’s Construction Schedule.
 2. Prepare the schedule in chronological order. Provide the following information:
 - a. Scheduled date for the first submittal
 - b. Related Section numbers
 - c. Submittal category (shop Drawings, Product Data, or Samples)
 - d. Name of the subcontractor
 - e. Description of the part of the Work covered
 - f. Scheduled date for resubmittal
 - g. Scheduled date for the Architect’s final release or approval
- B. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project meeting room and field office.
 1. When revisions are made, distribute to the same parties and post in the same location. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

1.6 SHOP DRAWINGS, PRODUCT DATA, SAMPLES, AND O & M MANUAL

- A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviation from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
- B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:
 1. Dimensions
 2. Identification of products and materials included by sheet and detail number
 3. Compliance with specified standards

4. Notation of coordination requirements
- C. Product Data includes printed information, such as manufacturer’s installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate applicable information. Include the following information:
 - a. Manufacturer’s printed recommendation
 - b. Compliance with trade association standard
 - c. Compliance with recognized testing agency standard
 - d. Application of testing agency labels and seals
 - e. Notation of dimensions verified by field measurement
 - f. Notation of coordination requirements
- D. Submit Samples in size as indicated in corresponding Specification Section. Samples include whole or partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern, cured and finished as specified, and physically identical with the material or product specified.
1. Prepare Samples to match the Architect’s sample. Include the following information:
 - a. Specification Section number and reference
 - b. Generic description of the Sample
 - c. Sample source
 - d. Product name or name of the manufacturer
 - e. Compliance with recognized standards
 - f. Availability and delivery time
 2. Provide minimum of two (2) samples for each item indicating sample submission unless otherwise indicated.
 3. Electronic submissions of color charts for color selection/verification will not be accepted.
- E. O & M Manual Information to include operating and maintenance requirements and suggested spare parts recommended by the manufacturer.
- F. Do not use Shop Drawings and Product Data without an appropriate final stamp indicating action taken.

1.7 FIELD MEASUREMENTS

- A. Verify all conditions, which may effect the execution of the Work.

- B. Report any major discrepancies between the estimated and actual amount of damage to the structural elements after removal of the existing roofing. Values in excess of twenty (20) percent above or under assumed or expected amounts shall be considered major.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION

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SECTION 01 43 00 QUALITY ASSURANCE

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 QUALITY ASSURANCE

- A. General Contractor Qualifications: Work shall be performed by a contractor having not less than five (5) years satisfactory experience on comparable projects including four (4) or more projects of similar scope that have been completed in the last four (4) years. These projects must include historic restorations.
- B. Finish Carpenter must have documentable experience in:
 - 1. Layout, reconstruction, and finishing of historic staircases.
 - 2. Reproductions of period woodwork, doors, and mantles, Federal is preferred.
 - 3. In-house production of custom moldings.
- C. Refer to individual specifications sections for additional Contractor Qualifications and submittal requirements specific to the scope of work described.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION

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SECTION 01 50 00 TEMPORARY FACILITIES

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 specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security, and protection.
- B. Specific locations to be used for temporary offices, parking, sanitary facilities, and Contractors' lay down areas shall be designated by the Owner.
- C. The Owner will review and have final approval on locations and routing of temporary services.
- D. Maintain and repair permanent work that is damaged as a result of temporary facilities work.
- E. Place temporary services into operation in an expedient manner so as to avoid any delay in the Work. When using utilities services paid for by the Owner, Contractor is expected to use such services judiciously.
- F. Temporary utilities include, but are not limited to,
 - 1. Water service and distribution: Owner will pay consumption cost.
 - 2. Temporary electric power and lighting: Owner will pay consumption cost.
- G. Temporary construction and support facilities required include, but are not limited to:
 - 1. Temporary enclosures
- H. Security and protection facilities required include, but are not limited to:
 - 1. Temporary fire protection
 - 2. Barricades, warning signs, lights
 - 3. Environmental protection
 - 4. Temporary fencing: Contractor shall provide fencing required for the security of his materials and equipment and fencing needed to protect and prevent public access to areas of his work that may pose safety hazards.

1.3 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to:
 - 1. Building code requirements
 - 2. Health and safety regulations

3. Utility company regulations
4. Police and Fire department rules
5. Environmental protection regulations

B. Inspections: Arrange for Authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certification permit.

1.4 FIELD MEASUREMENTS

A. Verify all conditions which may effect the execution of the Work.

1.5 TEMPORARY UTILITIES

A. Temporary Electricity:

1. Coordinate use of existing electric service with owner.
2. Cost: By Owner; connect to Owner's existing power service. Do not disrupt Owner's use of service. Owner will pay cost of energy used. Exercise measures to conserve energy.
3. Provide temporary electric feeder from existing building electrical services as required.
4. Complement existing power services capacity and characteristics as required.
5. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.

B. Temporary Lighting for Construction Purposes:

1. Provide and maintain lighting as necessary for construction operations.

C. Temporary Ventilation:

1. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors or gasses.

D. Telephone and Internet Services:

1. Contractor shall provide own Telephone and Internet services.

E. Temporary Water Service:

1. Coordinate use of existing water source with owner.
2. Owner will pay cost of water used. Exercise measures to conserve water.

1.5 TEMPORARY FACILITIES

A. Temporary Sanitary Facilities:

1. Contractor to provide temporary facilities during construction operations, for contractors' use, in a location to be agreed with Owner.

B. Protection of Installed and Existing Work:

1. Protect installed and existing work and provide special protection where specified in individual specification sections.
2. Provide temporary and removable protection for installed products. Control

- activity in immediate work area to prevent damage.
- 3. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- 4. Protect finished floors, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- C. Security:
 - 1. Provide security and facilities to protect work, existing facilities, and Owner’s operations from unauthorized entry, vandalism, or theft.
 - 2. Coordinate with Owner’s security program.
- D. Progress Cleaning and Waste Removal:
 - 1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
 - 2. Remove debris and rubbish from pipe chases, plenums, and other closed or remote spaces, prior to enclosing the space.
 - 3. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
 - 4. Collect and remove waste materials, debris, and rubbish from site daily and dispose off-site.
 - 5. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.
- E. Parking:
 - 1. On-site parking will be provided by the Owner in designated areas.
 - 2. Access to the site is available at all reasonable hours, coordinate with Owner.
- F. Temporary Storage:
 - 1. Storage of any kind is not permitted inside any existing building or any area not authorized for storage.
 - 2. The contractor is to provide temporary storage trailers suitable for weathertight storage in the area designated for this purpose by the Architect.

1.6 REMOVAL OF UTILITIES, FACILITIES, AND CONTROL

- A. Remove temporary utilities, equipment, facilities and materials prior to Substantial Completion inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION

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SECTION 01 78 00 DOCUMENTATION AND CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY:

- A. This Section includes administrative and procedural requirements for project closeout such as, and not limited to:
 - 1. Inspection procedures
 - 2. As-built document preparation and submittal
 - 3. Project closeout document submittals
 - 4. Operating and maintenance manual submittals
 - 5. Submittal of warranties & guaranties
 - 6. Final cleaning

- B. Comply with additional closeout requirements, if any, in Divisions 2 through 31.

PART 2 – PRODUCTS

PART 3 – EXECUTION

3.1 PLANNING AND PREPARATION

- A. Construction Schedule: Prior to signing Contract Agreement, submit to the Architect a Contractor’s Project Schedule in sufficient detail to indicate major work activity types, and their start dates and finish date. Include also in the schedule; periods for Mobilization, Shop Drawing Submittals, De-mobilization, Substantial Completion, Closeout Document Submittals, and Final Completion.

- B. Schedule of Values: Within 14 days after receiving the Notice to Proceed, submit to the Architect a draft Schedule of Values on AIA Form G703 – Application for Payment Continuation Sheet, or in other form acceptable to the Architect. Include sufficient detail to allow reasonable evaluation of work in place, the labor required to accomplish the work, and stored materials (both on-site and off-site). Revise the draft until acceptable to the Architect.

- C. Plan Approval Documents: Upon mobilization, secure on site, the set of construction documents bearing the approval stamps and comments affixed by government authorities (“Plan Approval Documents”). Do not use these documents for routine project activities. Append the Plan Approval Documents with copies of approved Change Orders. Make the documents available to the Owner, Architect, and authorized government authorities upon request. Submit the As-built Documents as described in this Section.

- D. As-built Documents: Upon mobilization to the site, secure one set of documents (Drawings, Project Manual, and Shop Drawings when appropriate) clearly marked

“Contractor As-Built Set.” Make the documents available to the Owner and Architect upon request; submit the As-built Documents as described in this Section.

1. Maintain a clean, undamaged set of the Project Manual (including specifications), Drawings, Change Orders, and Shop Drawings.
 2. During the construction period, and as an activity occurs, mark the set using colored pencils to show the actual installation when it varies substantially from the Work as originally shown. Consistently use specific pencil marking colors to distinguish between separate categories of the Work.
 3. Mark new information that was not shown on Contract Drawings or Shop Drawings, but is likely to be important or useful to the Owner, or will be useful to future contractors, architects, and engineers.
 4. Indicate locations of items or concerns that will be concealed from view. For subgrade objects, provide dimensions from permanent, visible objects and indicate the depth below grade.
 5. Mark whichever drawing is most appropriate for showing conditions fully and accurately. When Shop Drawings are used, record a cross reference at corresponding locations on Contract Drawings.
 6. Mark related Change Order numbers and Architect’s field directives where applicable.
- E. Within 30 days of the Commencement Date, submit a draft of the Operating and Maintenance Manual(s) for the Architect’s review and approval as further described in the Section.

3.2 PRIOR TO REQUESTING SUBSTANTIAL COMPLETION INSPECTION

- A. As applicable for the project, compile and begin assembly of Project Record Information, such as Operating and Maintenance Manuals, final project photographs, as-built Project Manual, Drawings, and Shop Drawings, warranties, certifications, government approved construction documents, damage or settlement survey, property survey, and similar final record information.
- B. Advise insurance and bond companies of project status.
- C. Submit written notice to the Owner of pending insurance change-over dates and related requirements.
- D. Ensure availability of specific warranties, maintenance agreements, final certifications, and similar documents.
- E. Complete start-up testing of devices and systems.

- F. Instruct Owner's personnel in the operation of all devices and systems.
- G. Submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
- H. Initiate demobilization from the site.

3.3 AFTER REQUESTING SUBSTANTIAL COMPLETION INSPECTION AND BEFORE THE INSPECTION DATE

- A. Remove temporary facilities from the site, as well as construction tools, mock-ups, and similar elements.
- B. Working with the Owner's Safety and Security Department, make final change-over of permanent locks and deliver keys to the Owner's Safety and Security Department.
- C. Complete final clean-up requirements, including touch-up painting and site cleaning. Touch-up and otherwise repair and restore finishes damaged during the Contract Period.
- D. Change billing of utilities from Contractor to the permanent user, as needed.
- E. Complete demobilization from the project site, including and not limited to:
 - 1. Remove tools and unused equipment and supplies.
 - 2. Remove and legally dispose of all trash, debris, and all temporary project signage.
 - 3. Remove temporary facilities and associated utilities.

3.4 AFTER SUBSTANTIAL COMPLETION AND BEFORE FINAL COMPLETION:

- A. Request Consent of Surety to Final Payment
- B. Deliver as-built documents and Operation and Maintenance Manuals to the Owner's Project Manager, unless instructed otherwise by the Owner's Project Manager.
- C. Deliver tools, spare parts, extra stock, and similar items.
- D. Submit Consent of Surety to Final Payment and release of liens.
- E. Submit a final liquidated damages settlement statement, if applicable.
- F. Submit final Application for Payment. Indicate percentages complete for all items. When 100 percent completion can not be shown, include a list of incomplete items, the value of incomplete construction, reasons the Work is not complete, and the anticipated date of completion.

3.5 OPERATING AND MAINTENANCE MANUALS

- A. Include the following types of information in each manual, in generally the order listed:
1. Table of Contents
 2. Emergency instructions
 3. Spare parts list
 4. Copies of warranties
 5. Manufacturer name w/ contact info.
 6. Installation company w/ contact info.
 7. Operation Instructions
 8. Maintenance Instructions
 9. Maintenance Schedules
 10. Maintenance Inspection Procedures
 11. Inspection Procedures
 12. Wiring diagrams
 13. Recommended “turnaround” cycles
 14. Shop Drawings and Product Data (including MSDS sheets)
 15. Fixture lamping schedule
 16. Filter replacement schedule
- B. Submit a draft of the Operating and Maintenance Manual(s) for the Architect’s review and approval.
1. Submit draft in hard-back 3-ring binder, identical to the proposed final binder, Binder to have clear vinyl insert sleeves on the front and the spine for inserting identification.
 - a. On cover insert, neatly printed or typewritten, the OHC Project Number and Name, Contractor name, address, and contact information, Commencement Date and Substantial Completion Date.
 - b. On spine insert, neatly printed or typewritten, include the OHC Project Number and Name, Commencement Date and Substantial Completion Date.
- C. Table of Contents, arranged to match applicable CSI specification section numbering or other appropriate arrangement for consideration.
- D. Provide multiple volumes when necessary to contain the information with no over filling of a binder. Clearly identify each volume as one volume of a set of several volumes, i.e., “Vol. 1 of 3, Vol. 2 of 3,” etc. on the front cover, the spine, and the Table of Contents.
- E. When the use of multiple volumes is appropriate or required, indicate such in the Table of Contents and provide the Table of Contents in each volume.
- F. Provide tabbed divider sheets with typewritten or neatly handwritten descriptions on the tabs.

- G. Revise and re-submit the draft as necessary to obtain the Architect's approval.
- H. Submit specific warranties, maintenance agreements, final certifications, and similar documents.

3.6 OPERATING AND MAINTENANCE INSTRUCTIONS AND TRAINING

- A. The installer of a device or piece of equipment that requires human operation or maintenance shall meet with the Owner's personnel and instruct them in the proper operation and maintenance of the devices and equipment.
- B. If installers are not experienced in operating and maintenance procedures, provide instruction by manufacturer's representatives that do have such experience.
- C. Provide a detailed review of the following items:
 - 1. Maintenance manuals
 - 2. Record documents
 - 3. Spare parts and materials
 - 4. Tools
 - 5. Lubricants
 - 6. Fuels
 - 7. Identification systems
 - 8. Control sequences
 - 9. Hazards / Safety Recommendations
 - 10. Cleaning
 - 11. Warranties and bonds
 - 12. Maintenance agreements and similar commitments
 - 13. Other information as appropriate.
- D. As part of instruction for operating equipment, demonstrate the following procedures:
 - 1. Start-up
 - 2. Shutdown
 - 3. Emergency operations
 - 4. Noise and vibration adjustments
 - 5. Safety procedures
 - 6. Economy and efficiency adjustments
 - 7. Effective energy utilization
- E. Warranty Period: Promptly assist and advise Owner's maintenance personnel to debug equipment. Promptly correct deficiencies during the warranty.

3.7 FINAL CLEANING

- A. Cleaning: Employ experienced workers or professional cleaners for final cleaning.

- B. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- C. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
 - 1. Remove labels that are not permanent labels.
 - 2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable or are vision-obscuring materials. Replace chipped or broken glass and repair or replace damaged materials.
 - 3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Leave concrete broom clean. Vacuum carpeted surfaces.
 - 4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances.
 - 5. Clean plumbing fixtures to a sanitary condition.
 - 6. Clean light fixtures and lamps.
 - 7. Clean the site, including landscape development areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted to a smooth, even-textured surface.
- D. Remove temporary protection facilities installed for protection of the Work during construction.
- E. Comply with regulations of authorities having jurisdiction and safety standards for cleaning.
- F. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property.
- G. Do not discharge volatile, harmful, or dangerous materials into drainage systems.
- H. Unless otherwise directed by Owner, remove waste materials from the site and dispose of legally.

END OF SECTION

SECTION 02 41 19 SELECTIVE DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Bidding Requirements, Contract Conditions, and Division 1 Specification. Sections in their entirety apply to this Section.

1.2 SUMMARY

- A. Related work specified elsewhere:
 - 1. Division 1, Section 01 11 00 Summary of Work
 - 2. Division 1, Section 01 33 00 Submittal Procedures
 - 3. Division 1, Section 01 50 00 Temporary Facilities
- B. Description of Work:
 - 1. Furnish all labor, materials, equipment, and services necessary to execute all Demolition Work as shown in the Contract Documents, scheduled and specified.
 - 2. Salvage and storage of brick pavers.

1.3 SITE INSPECTION

- A. Visit the site and become thoroughly familiar with the existing conditions.
- B. Report to the Architect any condition not adequately covered by the Project Manual.

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for demolition work, safety of structure, dust control, products requiring electrical disconnection and/or reconnection.
- B. Obtain any required demolition permits from authorities.
- C. Do not close or obstruct egress width to any space or exit-way unless approved in writing.
- D. Do not disable or disrupt building fire or life safety systems without 3 day written notification to the Owner.
- E. Conform to regulatory procedures applicable when hazardous or contaminated materials are discovered.

1.5 SEQUENCING

- A. Sequence demolition work in the reverse order of normal construction procedures.

1.6 SCHEDULING

- A. Schedule work under the provisions of Section 01 33 00.
- B. Schedule work to coincide with other construction.
- C. Perform noisy, odor-producing, or dusty work when such activities will not disrupt normal museum activities; coordinate at discretion and approval of Owner.

1.7 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Cease operations immediately if structure appears to be in danger and notify Architect. Do not resume operations until directed.
- C. Maintain protected egress and access to the Work.

PART 2 – NOT USED

PART 3 – EXECUTION

3.1 PREPARATION

- A. Provide, erect, and maintain temporary barriers at locations indicated or required.
- B. Install covers as necessary to insure weather-tightness of roof at the conclusion of each day's activities.
- C. Erect and maintain weatherproof and insulated closures for exterior openings.
- D. Erect and maintain temporary partitions to prevent the spread of dust, odors, and noise to permit continued Owner occupancy.
- E. Provide appropriate temporary signage including signage for exit or building egress.

3.2 DEMOLITION

- A. Prior to beginning the selective demolition work, review with the Architect the building components which are:
 - 1. to be reincorporated into the finished project
 - 2. to be stored as directed by the Architect
 - 3. to become the Contractor's property and be removed from the site.

- B. All demolition work shall be performed in an orderly and professional manner.
- C. Use care not to damage adjoining surfaces and work scheduled to remain. Damages to surfaces scheduled to remain or adjoining work shall be repaired, patched or replaced to the satisfaction of the Architect at the expense of the Contractor that caused the damage.
- D. Control dust to the absolute minimum at all times, inside and outside of the building.
- E. Keep noise to a minimum. The use of pneumatic tools is not permitted.
- F. Remove demolished material from site, except where specifically noted otherwise. The Owner reserves the right to maintain possession of any materials removed from the existing structure.

3.3 CLEAN-UP

- A. Remove materials from the site as work progresses. Maintain area as clean and orderly as possible during the course of work. Clean up completely at the end of each work day.
- B. Upon completion of work leave areas in clean condition.

END OF SECTION

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SECTION 033000 - CAST-IN-PLACE CONCRETE

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, if provided, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Slabs-on-grade.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- B. Concrete Design Mixtures: Prepare design mixture report for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- C. Concrete Tests: Testing report of composite samples of fresh concrete obtained according to ASTM C 172.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

PART 2 - PRODUCTS**2.1 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- C. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I, gray. 3000 PSI minimum.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.4 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.5 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Combined Fly Ash and Pozzolan: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

2.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION**3.1 FORMWORK**

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 48 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
- C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi at 28 days.
 4. 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.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3.10 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. 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. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
1. Steel reinforcement placement.
 2. Concrete placement, including conveying and depositing.
 3. Curing procedures and maintenance of curing temperature.
 4. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 4. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall

contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

5. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
6. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
7. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
8. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 04 01 20 MASONRY RESTORATION

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, but is not limited to, restoration of masonry consisting of:
 1. Removal of arched brick hearth support structures
 2. Repair and partial rebuilding of original fire boxes
 3. Tuck pointing of original fire boxes and exposed fireplace surfaces
 4. Tuck pointing and repair of brick wall surfaces exposed by plaster removal
 5. Install new sand setting beds in fireplace hearths
 6. Install new unmortared brick fireplace hearths

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.
- B. Samples are to be submitted for the following:
 1. Replacement Brick: Submit (3) samples of replacement brick for matching.
 2. Pointing and Repair Mortar: Submit sets of mortar for pointing
 - a. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of material for masonry restoration (face brick, patching compound, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.
- B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage due to worker fatigue.

- C. Restoration Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of restoration work including protection of surrounding materials and Project site.
 - 1. If materials and methods other than those indicated are proposed for any phase of restoration work, add to the Quality-Control Program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project and worker's ability to use such materials and methods properly.

- D. Mockups: If requested by Architect, prepare mockups of restoration and paint removal to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation.
 - 1. Masonry Repair: Prepare sample areas for brick and stone repair materials. Erect sample areas in existing walls unless otherwise indicated, to demonstrate quality of materials, workmanship, and blending with existing work.
 - 2. Repointing: Rake out joints in 2 separate areas, each approximately 16 inches high by 16 inches wide for each type of repointing required and repoint one of the areas.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- E. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to masonry restoration and cleaning including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, Restoration Specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Materials, material application, sequencing, tolerances, and required clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons.
- B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.
- E. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.6 COORDINATION

- A. Coordinate masonry restoration and cleaning with public circulation patterns at Project site. Some work is near public circulation patterns. Public circulation patterns cannot be closed off entirely, and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

1.7 SEQUENCING AND SCHEDULING

- A. Order replacement materials at earliest possible date to avoid delaying completion of the Work.
- B. Perform masonry restoration work in the following sequence:
 - 1. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
 - 2. Replace existing masonry with new masonry materials.
 - 3. Rake out mortar from joints to be repointed.
 - 4. Point mortar joints.
 - 5. Replacement and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
 - 6. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

- A. ~~Face Brick: Provide exterior brick where required to complete areas of masonry restoration. Provide units with dimensions, color, and texture compatible with existing brick.~~
- B. ~~Interior Brick: Provide interior brick where required to complete areas of masonry restoration where multiple layers are required.~~
 - 1. ~~Provide interior units with dimensions compatible with face brick.~~

2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type II, white or gray or both where required for color matching of exposed mortar.
 - 1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.

- C. Mortar Sand: ASTM C 144 unless otherwise indicated.
 - 1. Color: Provide natural sand of color necessary to produce required mortar color.
 - 2. For pointing mortar, provide sand with rounded edges.
 - 3. Match size, texture, and gradation of original mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match. Owner's consultant to analyze and provide formal for Historic mortar.
- D. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.
- E. Water: Potable.
- F. ~~Sealer: Cathedral Stone Products masonRE R-97 water repellent~~

2.3 MORTAR MIXES

- A. Do not use admixtures in mortar unless otherwise indicated.
- B. Mortar Proportions: Mix mortar materials in the following proportions:
 - 1. Pointing Mortar for Brick: 1 part portland cement, 2 parts lime, and 8 parts sand.
 - 2. Rebuilding (Setting) Mortar: Same as pointing mortar.

2.4 REPOINTING MASONRY

- A. Rake out and repoint joints to the following extent:
 - 1. All joints in areas indicated.
 - 2. Joints where mortar is missing or where they contain holes.
 - 3. Cracked joints where cracks are 1/16 inch or more in width and of any depth.
 - 4. Joints where they sound hollow when tapped by metal object.
 - 5. Joints where they have been filled with substances other than mortar.
 - 6. Sealant-filled joints.
- B. Do not rake out and repoint joints where not required.
- C. Rake out joints as follows, according to procedures demonstrated in approved mockup:
 - 1. Remove mortar from joints to depth of joint width plus 1/8 inch, but not less than 1/2 inch (13 mm) or not less than that required to expose sound, unweathered mortar.
 - 2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
 - 3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

- a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
 - b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.
- D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
- E. Pointing with Mortar:
- 1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
 - 2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
 - 3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch (9 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer.
 - 4. Mortar joints on repointing work to be flush. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
 - 5. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
 - 6. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.
 - a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
 - b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.
 - 7. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

2.5 FINAL CLEANING

- A. 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 (100 psi to 300 psi).
- 1. Do not use metal scrapers or brushes.
 - 2. Do not use acidic or alkaline cleaners.

- B. Wash adjacent woodwork and other non-masonry surfaces. Use detergent and soft brushes or cloths.
- C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

2.6 MANUFACTURED REPAIR MATERIALS

- A. ~~Stone and Brick Patching Compounds: Factory mixed cementitious product that is custom manufactured for patching masonry.~~
 - 1. ~~Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:~~
 - a. ~~Cathedral Stone Products, Inc.; Jahn Restoration Mortars.~~
 - b. ~~Conproco Corporation; Maxtrix~~
 - c. ~~Edison Coatings, Inc.; Custom System 45.~~
 - 2. ~~Use formulation that is vapor and water permeable (equal to or more than the original brick or stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all types of masonry.~~
 - 3. ~~Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.~~
 - 4. ~~Formulate patching compound in colors, textures, and grain to match brick or stone being patched. Provide sufficient number of colors to enable matching each piece of original materials.~~

PART 3 – EXECUTION

3.1 PROTECTION

- B. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from stone restoration work.
 - 1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.
- C. Prevent mortar from staining face of surrounding stone and other surfaces.
 - 1. Cover sills, ledges, and projections to protect from mortar droppings.
 - 2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
 - 3. Immediately remove mortar in contact with exposed stone and other surfaces.

Clean mortar splatters from scaffolding at end of each day.

END OF SECTION

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SECTION 06 10 53 ROUGH CARPENTRY

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.
- B. Related work specified elsewhere:
 - 1. Section 06 20 13 Finish Carpentry
- C. Description of Work:
 - 1. Framing and blocking per drawings.

1.3 SUBMITTALS

- A. Provide manufacturer's standard nail patterns and list of nail sizes required for the Architect's pattern selection.

1.4 PROJECT CONDITIONS

- A. Coordination
 - 1. Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location for furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

1.5 PRODUCT HANDLING

- A. Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and provide air circulation within stacks.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plywood:
 - 1. Trademark: Identify each plywood panel with appropriate APA trademark.
 - 2. Concealed performance rated plywood: Where plywood panels will be used for concealed types of applications, provide APA performance rated panels complying with requirements indicated for grade designation span rating, exposure durability classification, edge detail (where applicable) and thickness.
- B. Lumber

1. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, and for moisture content specified for each use.
 2. Provide dressed lumber S4S, unless otherwise indicated.
 3. Provide kiln-dried lumber with 15% maximum moisture content at time of dressing.
- C. Miscellaneous materials:
1. Fasteners and anchorages: Provide size, type of material and finish as indicated and as recommended by applicable standards, complying with applicable Federal specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General
1. Discard material with defects which might impair the quality of work.
 2. Set carpentry work accurately to required levels and lines, with members plumb, true, accurately cut and fit.
 3. Coordinate all work with other trades, provide blocking, nailers, anchors and moisture barriers as may be required.
 4. Particular attention shall be given to the execution of details as shown on the Drawings.

3.2 CLEAN-UP

- A. Keep areas as clean and neat as practical during the course of the work. Clean up completely at the end of each work day.
- B. Remove all debris and rubbish on a daily basis.

END OF SECTION

SECTION 06 20 13 FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Bidding Requirements, Contract Conditions, and Division 1 Specifications Sections in their entirety apply to this Section.
- B. Related work specified elsewhere
 - 1. 09 91 00 Painting

1.2 SUMMARY

- A. Section includes, but is not limited to, new and restoration carpentry consisting of:
 - 1. Install wood blocking and nailers in masonry as necessary for installation of wood trim. Wood blocking to be set in place with epoxy adhesive.
 - 2. Install wood trim provided by others, including window and door casings, baseboards, closet shelving, etc..
 - 3. Finish nails are to be used for attachment of all trim, mantels, etc. The use of trim screws is prohibited.
 - 4. Gaps between brick wall and frames, casings and trim work in exterior walls are to be stuffed with batt or foam insulation prior to installation of woodwork.
 - 5. Repair all splits, gouges, and other imperfections in existing millwork with “Dutchman” style repairs or epoxy filler as directed by owner’s representative.
 - 6. Door leaf installation by others.
 - 7. Holes left from removed electrical boxes should be patched with a “Dutchman” style repair, filled, and sanded perfectly smooth with the surrounding surface.
 - 8. Repair missing or damaged original floorboards using white pine of a matching dimension. Preserve as much of the original wood flooring as possible. Coordinate extent of each repair with owner’s representative.
 - 9. Floorboard ends cut back short of walls to be repaired by screwing a supporting cleat through the existing floorboards to support a patch running perpendicular to the original boards.
 - 10. Missing or damaged floorboards running parallel to flooring should be patched by removing damaged section and replacing floorboard to the next joist centerline on either side of the repair.
 - 11. Holes from removed electrical boxes, pipes, and other small holes should be patched with a “Dutchman” style wood repair.
 - 12. Previous un-staggered flooring patches which are structurally sound and flush with the surrounding floor are to remain in place.

1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Millwork Fabricator Qualifications: A firm specializing in the fabrication of millwork with a satisfactory record of performance on project of comparable size and quality. Fabricator shall be acceptable to Architect.
- C. Installation: Performed only by experience skilled finish carpenters.

1.4 SUBMITTALS

- A. Provide manufacturer's product data for all materials (with particular attention to wood consolidants and fillers).
- B. Qualification Data: For Installer and fabricator
- C. Submit Shop Drawings for finish carpentry and millwork items including but not limited to china cabinet reconstruction and wood trim profiles.
 - 1. Provide large scale details. Indicate materials, component profiles, fastening and jointing details, and accessories.
- D. Submit samples of hardwood lumber and paneling, showing species, grade, profile, and cut proposed for the work.
- E. Submit samples of 1x material to be used for entablature, fascia, and soffit replacement on front porch.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect finish carpentry and millwork materials during delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver finish carpentry and millwork materials until concrete, masonry and other similar wet work has been completed and is thoroughly dry, outside door openings are permanently watertight, exterior windows are glazed and, in case of temperature dropping below 60°F., until temporary heating and ventilating systems are in operation.
- C. Store materials in dry well-ventilated spaces with constant minimum temperature of 60°F., and maximum relative humidity of 55%.

1.6 JOB CONDITIONS

- A. Conditioning:
Condition architectural woodwork by placing materials in conditioned space at least 5 five days prior to start of installation.

Open sealed packages of architectural woodwork to permit natural adjustment of moisture content and allow architectural woodwork to acclimate to room conditions.

D. Field Measurements:

Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

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. When replacing, scarfing, or patching wood, match existing wood profile and size.

B. Wood consolidant and replacement compound:

1. ABATRON, INC., 5501 95th Avenue, Kenosha, WI 53144. Tel: (262) 653-2000, Fax: (262) 653-2019, Orders: 800-445-1754. www.abatron.com.

2. Material Application for Wood consolidant and replacement compound:

- a. Wood Consolidant: LiquidWood
- b. Wood Replacement Compound/structural adhesive putty: WoodEpoxy

2.2 LUMBER, GENERAL

A. Miscellaneous Lumber:

1. Provide wood for support or attachment of other work including bucks, nailers, blocking, furring, grounds, stripping and similar members. Provide lumber of sizes shown or specified, worked into shapes shown, and as follows:

- a. Moisture content: 15% maximum for lumber items not specified to receive wood preservative treatment.
- b. Grade: Construction grade light framing size lumber, any species as required.

B. Replacement in Kind

1. For existing running trim, windows, doors, thresholds, and other woodwork to be repaired, test and match existing wood in species, profile and size exactly.

2. Replacement wood shall be kiln-dried to 12% maximum moisture content.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners and anchorages: Provide size, type of material and finish as indicated and as recommended by applicable standards, complying with applicable Federal specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices.
- B. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content
- C. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Discard units of new material with defects which might impair quality of work, and units which are too small to fabricate work with minimum joint arrangement.
- C. Use stainless steel nails, except in areas not exposed to the outside or that will receive finish materials.
- D. Select fasteners of size that will not penetrate members where opposite side will be exposed to view. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.
- E. Install repairs to match existing adjacent work.
- F. Fill gaps, if any, between top of base and wall with sealant, sand smooth, and finish same as wood base if finished.
- G. Install standing and running trim with no more variation from a straight line than 1/8inch in 96 inches.

3.2 CLEAN-UP

- A. Keep areas as neat and clean as possible during the course of the work.
- B. Clean up completely at the end of each work day.

END OF SECTION

SECTION 09 01 20 – PLASTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. "Instructions to Bidders," "Form of Agreement Between Owner and Contractor," "General Conditions" and "Supplemental General Conditions" in their entirety are a part of this Section.

1.2 DESCRIPTION

- A. Related work specified elsewhere:
 - 1. Division 06 Section "Rough Carpentry"
 - 2. Division 06 Section "Finish Carpentry"
- B. The work of this Section includes, but is not limited to, the following:
 - 1. Plaster repair at holes made for electrical devices, wiring, HVAC, etc.
 - 2. Repair of loose or delaminated areas of plaster.
 - 3. Repair all cracks and surface imperfections in plaster. Tape and plaster all wall and ceiling plane intersections at corners.

1.3 QUALITY CONTROL

- A. All work shall be performed by skilled Installers having not less than five (5) years satisfactory experience in the installation and repair of lime-based plaster.
 - 1. Only skilled workers who are familiar and experienced with the materials and methods specified shall be used for plaster repair work.
 - 2. In acceptance or rejection of the plaster repair work, no allowance will be made for the lack of skill on the part of the workers.

1.5 SUBMITTALS

- A. Product data
 - 1. Submit manufacturer's product specifications and installation instructions for plaster composition, mixing, and application.
 - 1. Include other data as may be required to show compliance with these Specifications.
- B. Submit qualifications and experience of all personnel scheduled for this work.
- C. Sample: With prior approval of location from Architect, complete plaster repair in designated area. Consult with Architect for approval of this sample before completing additional work.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

- B. Store materials inside, under cover and in a manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes.

1.7 PROJECT CONDITIONS

- A. Environmental requirements:
 - 1. Comply with requirements of referenced gypsum plaster applications standards and recommendations of environmental conditions before, during and after application of plaster repairs.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following:
 - 1. Plaster materials and related products:
 - a. LimeWorks.us
 - b. US Heritage Group
 - c. Lancaster Lime Works

2.2 MATERIALS

- A. Lime Plaster
 - 1. Scratch Coat: LimeWorks.us TAKCOAT lime plaster base
 - 2. Brown Coat: LimeWorks.us TOPCOAT lime plaster, course-sanded grade G
 - 3. Finish Coat (Brown): LimeWorks.us TOPCOAT lime plaster, course-sanded grade F

Miscellaneous materials

- 1. Provide auxiliary materials for plaster work of the type and grade recommended by the manufacturer of the material including but not limited to wood lath.

PART 3 - EXECUTION

3.1 Plaster Repair

- A. Before beginning plaster work, verify proper placement of new electrical devices, HVAC registers, etc. in the wall. Coordinate any adjustments necessary before proceeding with plaster work.
- B. Remove all loose material down to wood lath or masonry.
- C. Replace missing wood lath with matching material.
- D. If over brick substrate, make all necessary repairs/repointing, and rake mortar joints back to provide keying for new plaster.
- E. Vacuum dust from surfaces.

- F. Apply approved bonding agent to existing surfaces.
- G. Apply scratch and brown coats to the proper thickness.
- H. Apply finish coat to bring surface to adjacent wall plane.
- I. Apply finish coat, feathering out repair into surrounding surface a minimum of 18”.

3.2 Crack Repair

- A. Remove material from crack.
- B. Vacuum dust from surfaces.
- C. Apply approved bonding agent to existing surfaces.
- D. Embed joint tape in repair for full length of crack.
- E. Apply finish coat feathering out repair into surrounding surface a minimum of 18”.

3.3 PROTECTION OF WORK

- A. Provide final protection and maintain conditions which ensure plaster repair work without damage or deterioration.

3.4 CLEAN-UP

- A. Maintain area as clean and neat as possible during work. Remove rubbish daily.
- B. Clean up completely when the plaster work is finished.

END OF SECTION

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SECTION 09 91 00 PAINTING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Bidding Requirements, Contract Conditions, and Division 1 Specifications Sections in their entirety apply to this Section.

1.2 SUMMARY

- A. The painting work includes but not limited to, the following:
 - 1. Surface prep, prime, and paint all wood trim, casings, panels, doors, windows, sashes, shelving, mantels, and other interior wood surfaces.
 - 2. Paint all interior plaster walls and ceilings.

1.3 QUALITY ASSURANCE

- A. Single source responsibility:
 - 1. Provide primers and other undercoat paint produced by the same manufacturer as finish coats.
 - 2. Use only thinners approved by paint manufacturer, and use only within recommended limits.
 - 3. Apply materials in accordance with Manufacturer's printed instructions.
- B. Coordination of Work:
 - 1. Contractor to coordinate paint removal, wood repairs, and drying methods.

1.4 SUBMITTALS

- A. Product data
 - 1. Submit manufacturer's technical information and application instructions for each material proposed for use.
- B. Samples
 - 1. Prior to ordering painting materials, Contractor to furnish manufacturer's color chips for color selection by Architect.
 - 2. When preparing samples for review, submit samples for Architect's review of color, texture and quality.
 - 3. Provide a listing of material and application for each coat of each finish sample
 - 4. Simulate finished lighting conditions for review of in-place work.
 - 5. Provide two identical 3' 0" x 6" x ¾" smooth planed wood samples, providing segments that clearly indicate the layering of each coating application, i.e. primer, second and third coat, as required to simulate actual conditions.
 - a. Resubmit samples as requested by Architect until acceptable sheen, color and texture is achieved.

1.5 DELIVERY AND STORAGE

- A. Deliver materials to job site in new and unopened packages and containers bearing manufacturer's name, label date of manufacture and batch number.
- B. Store materials not in actual use in tightly covered containers. Maintain used containers of paint in a clean condition, free of foreign materials and residue.
 - 1. Protect materials from freezing.
 - 2. Keep storage area neat and orderly. Remove oily rags and waste daily.
 - 3. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.6 JOB CONDITIONS

- A. Apply caulks, primers, paints, etc. only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F (0 degrees C) and 95 degrees F (35 degrees C), unless otherwise permitted by paint manufacturer's printed instructions.
- B. Apply coatings in strict accordance with the manufacturers' written instructions,

PART 2 – MATERIALS

2.1 MANUFACTURER

- A. Specification is based on Sherwin-Williams Company's Products. Substitution Manufacturer must be approved by the Architect before award of Contract.
- B. Acceptable (Wood Paint) Manufacturers:
 - 1. Benjamin Moore
 - 2. Glidden Coatings
 - 3. Pratt & Lambert Inc.

2.2 MATERIALS

- A. Material quality:
 - 1. Provide the best quality grade of various types of coatings by acceptable paint materials manufacturers.
 - a. Materials not displaying manufacturer's identification as required will not be acceptable.
- B. Accessory materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

1. Thinners, when necessary, shall only be those as recommended by the manufacturer of the paints being thinned.
- C. All materials used in the work shall be the first line product of the manufacturer specified. Materials not displaying manufacturer's identification as a standard first line product will not be acceptable. A list of such products, including brand names and numbers, shall be submitted to the Architect before commencing work.
1. Equal products shall contain not less than an equal percentage of solids by volume content of products specified.
 2. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated Pigments shall be applicable types to suit substrates and service indicated. Provide pigments fully ground, maintaining a soft paste consistency in the vehicle during storage, readily and uniformly dispersed by paddle to a completely homogeneous mixture ready for use.
 3. Each primer shall be of a suitable type for the surface, compatible with the specified finish paint and recommended by the manufacturer of the finish coat.
 4. Provide intermediate coat products compatible with finish coat and as produced by manufacturer of the finish coat.
 5. Provide ready-mixed paint, except for field catalyzed coatings. Job mixing and tinting is not acceptable.
 6. No other paints shall be brought to job. No dryers shall be added at the job.
- D. Material Application - Interior
1. Coating System. Wood Trim, Doors, and Windows:
 - a. Primer: Zinser Oil Based Primer
 - b. First Coat: Duration Interior Latex Semi-gloss colors per finish schedule
 - c. Second Coat: Duration Interior Latex Semi-gloss colors per finish schedule
 - d. Application:
 - 1) Primer: brush or spray and back-brush. Sand smooth after drying
 - 2) First coat: brush or spray and back brush
 - 3) Second and third coat (if necessary): brush or spray and back-brush
 2. Coating System. Plaster Walls & Ceilings:
 - a. Primer: Sherwin Williams Premium Wall and Wood Primer
 - b. First and Second Coat: Duration Interior Latex, finish and color by finish schedule
 3. Application method: walls

- a. First coat: brush, using continuous vertical stroke in direction specified in field by Architect.
- b. Second and third coat (if necessary): brush, using continuous in direction specified in field by Architect
- 4. Application method: ceilings
 - a. First coat: brush, using continuous stroke in direction specified in field by Architect.
 - b. Second and third coat (if necessary): brush, using continuous stroke in direction specified in field by Architect.
- 6. Drying time:
 - a. Recoat as recommended by manufacturer.
 - b. Lightly sand between coatings.
- F. Caulking: Sherwin Williams 950A Siliconized Acrylic Latex Caulk
- H. Material quality:
 - 1. Provide the best quality grade of various types of coatings by acceptable paint materials manufacturers.
 - 2. Materials not displaying manufacturer's identification as required will not be acceptable.
- I. Upon completion of job, remove all paint spots, touch-up and restore all damaged finishes, and remove and dispose of accumulated trash and debris.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Do not start work on unsatisfactory substrates. Starting of work shall be construed as acceptance of surfaces and conditions within any particular area.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 MATERIALS PREPARATION

- 1. Mix and prepare painting materials in accordance with manufacturer's instructions.
- 2. Maintain containers used in mixing of paint in a clean condition, free of foreign materials and residue.
- 3. Stir materials before application to produce a mixture of uniform density, and stir as required during application.
- 4. Do not stir surface film into material. Remove film and strain material before using.

3.3 APPLICATION

- A. General:
1. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
 2. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance.
 3. Give special attention to insure that surfaces such as edges, corners, crevices, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Sand lightly between each succeeding coat.
 5. Window panes to be cut in with crisp, professional lines and clean, 90 degree corners. After all painting is completed, clean glass free of drips, spatter, dirt, etc.
- B. Scheduling painting:
1. Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 2. Allow sufficient time between successive coatings to permit proper drying.
 3. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- C. Minimum coating thickness:
1. Apply each material at a spreading rate to establish the wet film and dry film thicknesses as recommended by the coating manufacturer.
- D. Prime coats:
1. Apply prime coats of material which is required to be painted or finished and which have not been prime coated by others.
 2. Recoat primed and sealed surfaces where there are suction spots or unsealed areas in first coat to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- E. Pigmented (opaque) finishes:
1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage.
 2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

3.4 CLEAN-UP AND PROTECTION

- A. Clean-up:

1. During process of work, remove from site discarded paint materials, rubbish, cans and rags at the end of each work day.
 2. Maintain work area as neat and orderly as possible.
- B. Protection:
1. Protect work of other trades whether to be painted or not, against damage by painting and finishing work.
 2. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
 3. Provide “Wet Paint” signs as required to protect newly painted finishes. Remove temporary protection wrappings provided by others of their work after completion of painting operations.
 4. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces

3.5 PAINT COLOR SCHEDULE

- A. Paint Color Schedule – contractor must coordinate with restoration coordinator for exact color locations before painting.

Tag	Paint Color, Type and Reflectance	Location Description
PT-1	SW 6385 Flat	Plaster Ceiling and Wall
PT-2	SW 6385 Semi-gloss	Trim, typ, unless noted otherwise
PT-3	SW 7006 Flat	Plaster Ceiling
PT-4	SW7105 Eggshell	Plaster Wall

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC

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 hangers and supports for HVAC system piping and equipment:
 - 1. Pipe hangers and supports.
 - 2. Fastener systems.
 - 3. Duct hangers and supports.
 - 4. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipe hangers and supports.

2. Powder-actuated fastener systems.
3. Anchors or supports set in epoxy.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.
 3. Grinnell Corp.
 4. National Pipe Hanger Corporation.
 5. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.3 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. Power-Strut Div.; Tyco International, Ltd.
 4. Thomas & Betts Corporation.
 5. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.

- B. Epoxy Anchors: steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti
 - b. Williams Wil-Bond
 - c. Simpson Epoxy-Tie
 - d. ITW Red Head Epcon

- C. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head.
 - d. Powers Fasteners.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1):
- E. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Riser Clamps (MSS Type 8): For support of pipe risers,

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- C. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1 ½ inches .

END OF SECTION 23 0529

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Valve tags.
 - 6. Warning tags.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.3 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 3. Fasteners: Stainless-steel rivets or self-tapping screws.
- B. Label Content: Include equipment's unique equipment number, description of size and function, and electrical characteristics.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and description of equipment size and function.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.3 DUCT LABELS

- A. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS AND LABELS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish or Self-Adhesive Warning Labels: Printed plastic with contact-type, permanent-adhesive backing.
1. Size: 3 by 5-1/4 inches minimum.
 2. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 3. Style, message, size and color as approved by OSHA.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 0553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Measuring sound and vibration.
 - 4. Reporting results of the activities and procedures specified in this Section.

1.2 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

- K. Test: A procedure to determine quantitative performance of a system or equipment.
- L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. NEBB: National Environmental Balancing Bureau.
- P. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS

- A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.
- B. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
- C. Sample Report Forms: Submit 2 sets of sample testing, adjusting, and balancing report forms.
- D. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.4 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.
- B. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
- C. Testing, Adjusting, and Balancing Reports: Use standard forms from SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."
- D. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards, or as described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

- E. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.5 PROJECT CONDITIONS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

- A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. National Project Performance Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- C. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified Agent has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)**PART 3 - EXECUTION****3.1 EXAMINATION**

- A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- G. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- H. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- I. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- J. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with indelible marker or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- C. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.

- G. Check for airflow blockages.
- H. Check condensate drains for proper connections and functioning.
- I. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multizone, dual-duct, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.
- B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each air-handling unit component.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

- C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- D. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.
- E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
 - 1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating if high-efficiency motor.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.7 CONDENSERS

- A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.8 TEMPERATURE TESTING

- A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.9 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Verify main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.10 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.
 3. Heating-Water Flow Rate: 0 to minus 10 percent.
 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.11 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of testing, adjusting, and balancing Agent who certifies the report.
 - 10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.

- c. Description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
 12. Data for terminal units, including manufacturer, type size, and fittings.
 13. Notes to explain why certain final data in the body of reports vary from design values.
 14. Test conditions for fans and pump performance forms, including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data: Include the following:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. ((sq. m)).
 - g. Design airflow rate in cfm (L/s).
 - h. Design velocity in fpm (m/s).
 - i. Actual airflow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- F. Air-Terminal-Device Reports: For terminal units, include the following:
1. Unit Data: Include the following:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft. ((sq. m)).
 2. Test Data: Include design and actual values for the following:

- a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary airflow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final airflow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).
- G. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
- 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Unit make and model number.
 - d. Manufacturer's compressor serial numbers.
 - e. Compressor make.
 - f. Compressor model and serial numbers.
 - g. Refrigerant weight in lb (kg).
 - h. Low ambient temperature cutoff in deg F (deg C).
 - 2. Test Data: Include design and actual values for the following:
 - a. Inlet-duct static pressure in inches wg (Pa).
 - b. Outlet-duct static pressure in inches wg (Pa).
 - c. Entering-air, dry-bulb temperature in deg F (deg C).
 - d. Leaving-air, dry-bulb temperature in deg F (deg C).
 - e. Condenser entering-water temperature in deg F (deg C).
 - f. Condenser leaving-water temperature in deg F (deg C).
 - g. Condenser water temperature differential in deg F (deg C).
 - h. Condenser entering-water pressure in feet of head or psig (kPa).
 - i. Condenser leaving-water pressure in feet of head or psig (kPa).
 - j. Condenser water pressure differential in feet of head or psig (kPa).
 - k. Control settings.
 - l. Unloader set points.
 - m. Low-pressure-cutout set point in psig (kPa).
 - n. High-pressure-cutout set point in psig (kPa).
 - o. Suction pressure in psig (kPa).
 - p. Suction temperature in deg F (deg C).
 - q. Condenser refrigerant pressure in psig (kPa).
 - r. Condenser refrigerant temperature in deg F (deg C).
 - s. Oil pressure in psig (kPa).
 - t. Oil temperature in deg F (deg C).
 - u. Voltage at each connection.
 - v. Amperage for each phase.
 - w. The kW input.
 - x. Crankcase heater kW.

- y. Number of fans.
 - z. Condenser fan rpm.
 - aa. Condenser fan airflow rate in cfm (L/s).
 - bb. Condenser fan motor make, frame size, rpm, and horsepower.
 - cc. Condenser fan motor voltage at each connection.
 - dd. Condenser fan motor amperage for each phase.
3. Air Data: Include design and actual values for the following:
- a. Duct airflow rate in cfm (L/s).
 - b. Inlet-duct static pressure in inches wg (Pa).
 - c. Outlet-duct static pressure in inches wg (Pa).
 - d. Average entering-air, wet-bulb temperature in deg F (deg C).
 - e. Average leaving-air, wet-bulb temperature in deg F (deg C).
 - f. Ambient wet-bulb temperature in deg F (deg C).

3.13 COMMISSIONING

- A. Make available, for 6-months following the substantial completion, a mechanical and a controls technician to assist the mechanical engineer in system commissioning. Technicians to be available on site for 2-days to perform systems tests and adjustments.

3.14 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 0593

SECTION 230700 - HVAC INSULATION**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. Insulation Materials
 - 2. Mastics
 - 3. Factory-applied jackets.
 - 4. Adhesives.
 - 5. Tapes.
 - 6. Securements.
- B. Related Sections:
 - 1. Division 23 Section "Metal Ducts" for duct liners.
 - 2. Division 23 Section "Refrigerant Piping" for refrigerant piping insulation.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
 1. Duct Wrap: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Soft-Touch.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Atmosphere Duct Wrap.
 - d. Owens Corning; SoftR
 2. Acoustical Duct Liner: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Toughguard
 - b. Johns Manville; Linacoustic
 - c. Knauf Insulation; Atmosphere Duct Liner
 - d. Owens Corning; Quiet R duct board.
 3. Pipe Insulation: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following;
 - a. Johns Manville; Micro-Lok
 - b. Knauf Insulation; Earthwool
 - c. Owens Corning; Fiberglas

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. +FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg .
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.5 TAPES

- A. FSK tape:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.6 SECUREMENTS

- A. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: , fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 3 inches o.c.
 - a. Apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches
- C. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies in accordance with building code requirements.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 - 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes,

vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.6 GENERAL DUCT INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 80 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 80 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches) o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches .

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 DUCT AND PLENUM INSULATION SCHEDULE

1. Attic Supply-air and return air duct insulation shall be the following:
 - a. Duct Wrap: minimum 2-inch nominal thickness, 1.5 LB/cu.FT nominal density.
 - b. FSK/FRK jacket to provide continuous vapor barrier
2. Interior Supply-air and return air duct insulation shall be the following:
 - a. Duct Wrap: minimum 1-inch nominal thickness, 0.75 LB/cu.FT nominal density.
 - b. FSK/FRK jacket to provide continuous vapor barrier

3.8 PIPE INSULATION SCHEDULE

- A. Condensate and equipment drainage:
 1. Pre-Formed Pipe Insulation with an R-value of 5.0 or greater and a thickness of 1-1/2 inch minimum.

END OF SECTION 23 0700

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

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. All new controls and components are to be an expansion of the existing controls system.
- B. The design is based on using a pre-configured control system including controllers, sensors, and user interface as detailed on the drawings. If an alternate controls vendor is considered, it shall comply to the requirements on the plans and in this section. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. BACnet: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.

3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
 - b. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
 - c. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
 - d. Relative Humidity: Plus or minus 2 percent.

1.5 SEQUENCE OF OPERATION

- A. Refer to Drawing M8.

1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- 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. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 3. Wiring Diagrams: Power, signal, and control wiring.
 4. Details of control panel faces, including controls, instruments, and labeling.

5. Written description of sequence of operation.
 6. Schedule of dampers including size, leakage, and flow characteristics.
 7. Schedule of valves including flow characteristics.
 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with BACnet.
- D. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.
 5. Software license required by and installed for DDC workstations and control systems.
- E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.

4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.7 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.9 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with any existing fire alarm and detection equipment to achieve compatibility.
- C. Coordinate supply of conditioned electrical branch circuits for control units.
- D. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- E. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

- A. Manufacturer: The system shall use products and programming from the following manufacturer:
 1. Mitsubishi Electric

- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

2.2 WEB-BASED USER INTERFACE

- A. Multifunctional presentation system with an embedded web server that allows access to BACNET-based networks via a web browser anywhere in the world, around the clock.
- B. Functionality to include complete remote configuration, trend logging, time scheduling, alarm and event monitoring, view and acknowledge of alarms.
- C. All web protocols fully support the http standard. This makes it easy to install in IT networks. Both normal proxy servers and reversed proxy servers are supported.
- D. Alarm and event monitoring features to allow users to perform a number of different actions over the Internet. Review alarm status and acknowledge alarms via a web browser, and also receive alarms via e-mail. Even external signals can be triggered, activating indicator lights or other devices.
- E. Trend logging managed via a web browser, through a local computer, and it is possible to start, stop, and clear the trend log remotely. Present the logs as bar graphs or in table format and archive them in a database.
- F. Complete remote configuration capability. All the configuration of the system can be performed remotely and system software upgrades can be performed quickly and easily through Internet downloads.
- G. COMMUNICATION
 1. Ethernet 10 Base-T
 2. BACnet
 3. RS232A
 4. Modem 9600-56000bps
 5. Modbus Master/Slave (option)
 6. RS232B
 7. PC-Connection
 8. M-Net

2.3 DDC EQUIPMENT

- A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - d. Remote communications.
 - e. Maintenance management.
 - f. Units of Measure: Inch-pound.

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. BACnet Compliance: Control units shall use BACnet protocol.

- B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 4. BACnet Compliance: Control units shall use BACnet protocol.

- C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 1. Binary Inputs: Allow monitoring of on-off signals without external power.

2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).
 6. Universal I/Os: Provide software selectable binary or analog outputs.
- D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and **72**-hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
 3. BACNET Compliance.
 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.5 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. RTDs and Transmitters:

1. Manufacturers:
 - a. ACI
 - b. Vaisala
 - c. Mitsubishi
2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 12-inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
7. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:
 - a. ACI
 - b. Vaisala.
 - c. Mitsubishi
2. Accuracy: 2 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
5. First five subparagraphs below are optional features.
6. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
7. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
8. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

2.6 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
 - a. Belimo Aircontrols (USA), Inc.
 2. Dampers: Size for running torque calculated as follows:
 - a. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - c. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - d. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm : Increase running torque by 2.0.
 3. Coupling: V-bolt and V-shaped, toothed cradle.
 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 6. Power Requirements (Two-Position Spring Return): 24-V ac.
 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 9. Temperature Rating: Minus 22 to plus 122 deg F.
 10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.

2.7 DAMPERS

- A. Manufacturers:
1. Air Balance Inc.
 2. Don Park Inc.; Autodamp Div.
 3. TAMCO (T. A. Morrison & Co. Inc.).
 4. United Enertech Corp.
 5. Vent Products Company, Inc.

- B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

2.8 CONTROL CABLE

- A. All control cable to be run in EMT as specified in Division 26.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that power supply is available to control.

3.2 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- E. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- F. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- G. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Section "Raceways and Boxes for Electrical Systems."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in Electric Metallic Tubing (EMT).
 - 3. Install concealed cable in Electric Metallic Tubing (EMT).
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 5. Test each system for compliance with sequence of operation.
 - 6. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Temperature:

- a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
6. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 7. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 8. Provide diagnostic and test instruments for calibration and adjustment of system.
 9. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 0900

SECTION 232300 - REFRIGERANT PIPING**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 RELATED DOCUMENTS

- A. Welding, brazing, and soldering will be allowed only with special permission from the Architect. Rules and requirements from General Conditions apply.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX; "Welding and Brazing Qualifications."
- B. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
- D. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.5 COORDINATION

- A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Reuse all existing pipe sleeve locations through foundation or wall penetrations.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- 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. Refrigerants:
 - a. Allied Signal, Inc./Fluorine Products; Genetron Refrigerants.
 - b. DuPont Company; Fluorochemicals Div.
 - c. Elf Atochem North America, Inc.; Fluorocarbon Div.
 - d. ICI Americas Inc./ICI KLEA; Fluorochemicals Bus.
 - 2. Refrigerant Valves and Specialties:
 - a. Sporlan Valve Company.
 - 3. Flexible Elastomeric Insulation
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex W

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR.
- B. Annealed-Temper Copper Tube: ASTM B 280, Type ACR
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver)
- F. Flexible Connectors: 500-psig minimum operating pressure; seamless tin-bronze core, high-tensile bronze-braid covering, and solder-joint end connections; dehydrated, pressure tested, minimum 7 inches long

2.3 VALVES

- A. Check Valves Smaller Than NPS 1: 400-psig operating pressure and 285 deg F operating temperature; cast-brass body, with removable piston, polytetrafluoroethylene seat, and stainless-steel spring; globe design. Valve shall be straight-through pattern, with solder-end connections.
- B. Check Valves, NPS 1 and Larger: 400-psig operating pressure and 285 deg F operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained polytetrafluoroethylene seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.
- C. Service Valves: 500-psig pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.
- D. Solenoid Valves: Comply with ARI 760; 250 deg F temperature rating and 400-psig working pressure; forged brass, with polytetrafluoroethylene valve seat, 2-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA 250 enclosure of type required by location, with 1/2-inch conduit adapter and 24-V, normally closed holding coil.
- E. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer of evaporator, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.
- F. Hot-Gas Bypass Valve: Pulsating-dampening design, stainless-steel bellows and polytetrafluoroethylene valve seat; adjustable; sized for capacity equal to last step of compressor unloading; with solder-end connections.

2.4 REFRIGERANT PIPING SPECIALITIES

- A. Moisture/Liquid Indicators: 500-psig maximum working pressure and 200 deg F operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.
- B. Replaceable-Core Filter-Dryers: 500-psig maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile-iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:
 - 1. Filter Cartridge: Pleated media with integral end rings, stainless-steel support, ARI 730 rated for capacity.
 - 2. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.
 - 3. Wax Removal Cartridge: Molded, bonded core of activated charcoal and desiccant with integral gaskets.

- C. Permanent Filter-Dryer: 350-psig maximum operating pressure and 225 deg F maximum operating temperature; steel shell and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.
- D. Mufflers: 500-psig operating pressure, welded-steel construction with fusible plug; sized for refrigeration capacity.

2.5 RECEIVERS

- A. Receivers, 6-Inch Diameter and Smaller: ARI 495, UL listed, steel, brazed, 400-psig pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- B. Receivers Larger Than 6-Inch Diameter: ARI 495, welded steel, tested and stamped according to ASME Boiler and Pressure Vessel Code: Section VIII; 400-psig pressure rating, with tappings for liquid inlet and outlet valves, pressure relief valve, and liquid-level indicator.

2.6 FLEXIBLE ELASTOMERIC INSULATION

- A. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials. Color shall be white.

2.7 REFRIGERANTS

- A. ASHRAE 34, R-22: Monochlorodifluoromethane.
- B. ASHRAE 34, R-410A: (50/50) Mix of Difluoromethane (R-32) and Pentafluoroethane (R-125).

2.8

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Aboveground, within Building: Type ACR drawn-copper tubing.
- B. Belowground: Pre-Insulated, Type ACR drawn-copper tubing.

3.2 VALVE APPLICATIONS

- A. Install check valves in condenser and hot gas reheat coil liquid lines.
- B. Install packed-angle valve in liquid line between receiver shutoff valve and thermostatic expansion valve for system charging.

- C. Install a full-sized, three-valve bypass around each dryer.
- D. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve.
 - 1. Install solenoid valves in horizontal lines with coil at top.
 - 2. Electrical wiring for solenoid valves is specified in Division 26 Sections. Coordinate electrical requirements and connections.
- E. Install thermostatic expansion valves as close as possible to evaporator.
 - 1. If refrigerant distributors are used, install them directly on expansion-valve outlet.
 - 2. Install valve so diaphragm case is warmer than bulb.
 - 3. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install pressure-regulating and pressure relief valves as required by ASHRAE 15. Pipe pressure relief valve discharge to outside.

3.3 PIPING INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 23 Section "Basic Materials and Methods for HVAC."
- C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Belowground, install copper tubing in protective conduit. Vent conduit outdoors. All conduit bends to be 45-degrees maximum.
- G. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- H. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.

3. Install traps and double risers to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- I. Install bypass around moisture-liquid indicators in lines larger than NPS 2.
 - J. Install unions to allow removal of solenoid valves, pressure-regulating valves, and expansion valves and at connections to compressors and evaporators.
 - K. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.
 - L. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
 - M. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 3. Pipe rollers for multiple horizontal runs 20 feet or longer, supported by a trapeze.
 4. Spring hangers to support vertical runs.
 - N. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 3. NPS 1 : Maximum span, 72 inches; minimum rod size, 1/4 inch .
 - O. Support vertical runs at each floor.

3.4 PIPE JOINT CONSTRUCTION

- A. Braze joints according to Division 23 Section "Basic Materials and Methods for HVAC."
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with the manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- E. Insulation Application (Indoors):
1. Flexible Elastomeric Insulation – 1-inches thick.
 2. Paint insulation, "Sections 09 9000 and 09 9100."
- F. Insulation Application (Outdoors):
1. UV Resistant Flexible Elastomeric Insulation – 2-Inches Thick.
 2. Paint insulation with Armacell WB White UV paint or equal.

3.6 FIELD QUALITY CONTROL

- A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
 2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.

- a. System shall maintain test pressure at the manifold gage throughout duration of test.
- b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
- c. Fill system with nitrogen to raise a test pressure of 150 psig or higher as required by authorities having jurisdiction.
- d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Check compressor oil level above center of sight glass.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves, except bypass valves that are used for other purposes.
 5. Check compressor-motor alignment, and lubricate motors and bearings.

3.8 CLEANING

- A. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

3.9 SYSTEM CHARGING

- A. Charge system using the following procedures:
 1. Install core in filter-dryer after leak test but before evacuation.
 2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 23 2300

SECTION 23 3113 - HVAC DUCTS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa). Metal ducts include the following:
1. Rectangular ducts and fittings.
 2. Round ducts and fittings.
 3. Flexible Duct
- B. Related Sections include the following:
1. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, and turning vanes..

1.2 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.3 SUBMITTALS

- A. Shop Drawings: Drawn to 1/4 inch equals 1 foot (1:50) scale. Show fabrication and installation details for metal ducts.
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 2. Duct layout indicating sizes and pressure classes.
 3. Elevations of top and bottom of ducts.
 4. Fittings.
 5. Reinforcement and spacing.
 6. Seam and joint construction.
 7. Penetrations through fire-rated and other partitions.
 8. Duct accessories, including access doors and panels.

9. Hangers and supports, including methods for duct and building attachment, vibration isolation, and seismic restraints.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Ceiling suspension assembly members.
 2. Other systems installed in same space as ducts.
 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATED FLEXIBLE DUCTS

- A. Insulated, Flexible Duct: UL 181, Class 1 Air Duct, resilient calendered film liner duct permanently bonded to a coated spring steel wire helix and supporting a fiberglass insulating blanket. Low permeability outer vapor barrier of fiberglass reinforced film.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Flex-Duct M-KE by Thermaflex; a Flex-Tek Group company;
 2. Pressure Rating, 4-inch to 12-inch Diameter: 10-inch wg positive and 1.0-inch wg negative.
 3. Maximum Air Velocity: 5,000 fpm.
 4. Temperature Range: Minus 20 to plus 250 deg F.
 5. Insulation R-Value: R4.2.

2.3 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.
- C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

- A. Hanger Materials: Galvanized sheet steel.
 - 1. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
- B. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.6 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Lockformer.
 - 2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
- D. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.7 ROUND DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal " and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal."

- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal," Figure 1-4, using corner, bolt, cleat, and gasket details.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Lockformer.
 - 2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
- D. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
 - 1. Supply Ducts: 2-inch wg.
 - 2. Supply Ducts (in Mechanical Equipment Rooms): 3-inch wg.
 - 3. Return Ducts (Negative Pressure): 1-inch wg.
 - 4. Return Ducts between Filter Sections (F-X) and Return Air Fans (RF-X) (Negative Pressure): 4-inch wg.
- B. All ducts shall be galvanized steel.

3.2 METAL DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.

- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Through-Penetration Firestop Systems."
- N. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."
- O. Paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.3 FLEXIBLE DUCT INSTALLATION

- A. Install flexible ducts only where noted on the plans.

- B. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- C. For detailed instructions on properly installing flexible ducts, see "Flexible Duct Performance & Installation Standards" (the Green Book) from ADC (www.flexibleduct.org/ADC_Pubs.asp). See Section 4, Installation Requirements.
- D. Install flexible ducts according to ADC's "Flexible Duct Performance & Installation Standards", Section 4, Installation Requirements.
- E. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- F. Install duct test holes where required for testing and balancing purposes.
- G. Installation:
 1. Install ducts fully extended.
 2. Do not bend ducts across sharp corners.
 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- H. Supporting Flexible Ducts:
 1. Suspend flexible ducts with bands 1-1/2 inches (38 mm) wide or wider and spaced a maximum of 48 inches (1200 mm) apart. Maximum centerline sag between supports shall not exceed 1/2 inch (13 mm) per 12 inches (300 mm).
 2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches (1800 mm) o.c.

3.4 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
 1. For pressure classes lower than 2-inch wg, seal transverse joints.
- B. Seal ducts before external insulation is applied.

3.5 HANGING AND SUPPORTING

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1." Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

- B. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- C. Building Attachments: Structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Use pan-head wood screws to secure strap hangers into the sides of floor joists.
 - 2. For duct runs perpendicular to the floor joists, provide a single 90-degree twist in the strap hanger.
 - 3. Break the cut ends of strap hangers to provide smooth ends and corners.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
 - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
 - 3. Determine leakage from entire system or section of system by relating leakage to surface area of test section.
 - a. Allowable Leakage, Supply Duct Systems: 1 percent of design airflow.
 - b. Allowable Leakage, Return Duct Systems: 2 percent of design airflow.
 - c. Allowable Leakage, Exhaust Supply Duct Systems: 2 percent of design airflow.
 - 4. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
 - 5. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.8 CLEANING NEW SYSTEMS

- A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
- B. Use service openings, as required, for physical and mechanical entry and for inspection.
 - 1. Create other openings to comply with duct standards.
 - 2. Disconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling sections to gain access during the cleaning process.
- C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.
- D. Clean the following metal duct systems by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- F. Cleanliness Verification:
 - 1. Visually inspect metal ducts for contaminants.
 - 2. Where contaminants are discovered, re-clean and reinspect ducts.

3.9 CLEANING EXISTING SYSTEMS

- A. Use service openings, as required, for physical and mechanical entry and for inspection.
 - 1. Use existing service openings where possible.
 - 2. Create other openings to comply with duct standards.
 - 3. Disconnect flexible ducts as needed for cleaning and inspection.
 - 4. Reseal rigid fiberglass duct systems according to NAIMA recommended practices.
 - 5. Remove and reinstall ceiling sections to gain access during the cleaning process.

- B. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or larger) particles.
 - 2. When venting vacuuming system to the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

- D. Clean the following metal duct systems by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.

- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Cleanliness Verification:

1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION 23 3113

SECTION 23 3300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Volume dampers.
 - 2. Turning Vanes
 - 3. Duct-mounting access doors.
 - 4. Flexible ducts.
 - 5. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For the following
 - 1. Volume dampers.
 - 2. Turning vanes.
 - 3. Duct-mounting access doors.
 - 4. Flexible ducts.
- 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. Special fittings.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 VOLUME DAMPERS

- A. Manufacturers:
 - 1. Air Balance, Inc.
 - 2. American Warming and Ventilating.
 - 3. Flexmaster U.S.A., Inc.
 - 4. McGill AirFlow Corporation.
 - 5. METALAIRE, Inc.
 - 6. Nailor Industries Inc.
 - 7. Penn Ventilation Company, Inc.
 - 8. Ruskin Company.
 - 9. Vent Products Company, Inc.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

- C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications. with linkage outside airstream,
 - 1. Steel Frames: Hat-shaped, galvanized stainless sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 - 3. Tie Bars and Brackets: Aluminum.
 - 4. Tie Bars and Brackets: Galvanized steel.

- D. Low-Leakage Volume Dampers: Multiple, opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 - 1. Steel Frames: Angle-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - 2. Roll-Formed Steel Blades: 0.064-inch-thick, galvanized sheet steel.
 - 3. Blade Seals: Neoprene.
 - 4. Tie Bars and Brackets: Galvanized steel.

- E. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

- F. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch-wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. METALAIRE, Inc.
 - d. Ward Industries, Inc.

- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.5 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
 - 1. Manufacturers:
 - a. American Warming and Ventilating.
 - b. CESCO Products.
 - c. Ductmate Industries, Inc.
 - d. Flexmaster U.S.A., Inc.
 - e. Greenheck.
 - f. McGill AirFlow Corporation.
 - g. Nailor Industries Inc.
 - h. Ventfabrics, Inc.
 - i. Ward Industries, Inc.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
 - 1. Manufacturers:
 - a. Flexmaster U.S.A., Inc.
 - 2. Frame: Galvanized sheet steel, with spin-in notched frame.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.6 FLEXIBLE DUCTS

- A. Flexible ducts are not permitted for this project.

2.7 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff. For ducts larger than 12 square inches in area, use a Low-Leakage opposed blade damper as described in this specification.
- F. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers and equipment.
 - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 - 4. On sides of ducts where adequate clearance is available.
- I. Install the following sizes for duct-mounting, rectangular access doors:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.

- 5. Body Access: 25 by 14 inches.
- 6. Body Plus Ladder Access: 25 by 17 inches.

- J. Label access doors.

- K. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

- L. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

- M. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.

- B. Adjust fire and smoke dampers for proper action.

- C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 3300

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes ceiling-, floor-, and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
 - 1. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
 - 2. Division 23 Section "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.2 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

1.3 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: Of diffusers, registers, and grilles, in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

PART 2 - PRODUCTS**2.1 MANUFACTURED UNITS**

- A. Diffusers, registers, and grilles are scheduled on Drawings. See Mechanical Schedules and Architectural details.

2.2 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 23 3713

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

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. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."

- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: 5 year(s) from date of Substantial Completion.
 - b. For Parts: 5 year(s) from date of Substantial Completion.
 - c. For Labor: 5 year(s) 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. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.

2.2 INDOOR UNITS (5 TONS OR LESS)

- A. Concealed Evaporator-Fan Components:
 - 1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - 2. Insulation: Faced, glass-fiber duct liner.
 - 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
 - 4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm); leak tested to 300 psig (2070 kPa) underwater; with a two-position control valve.

5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
6. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Condensate Drain Pans:
 - a. Fabricated with 1 percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 2-inches deep.
 - b. Single-wall, galvanized-steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1.
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
 - e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
9. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
 - b. Extended-Surface, Disposable Panel Filters:
 - 1) Factory-fabricated, dry, extended-surface type.
 - 2) Thickness: 2 inches.

- 3) Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
- 4) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.3 OUTDOOR UNITS (6 TONS OR MORE)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Inverter-Driven compressor motor with turndown to 18% of total capacity.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube with corrugated plate fins. Fins to have factory applied blue-fin finish. Coil to have 4 circuits with two-position valves on each circuit.
3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Variable-speed, permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Kit: Permits operation down to 23 deg F in cooling mode and -4 deg F in heating mode.
6. Mounting Base: Polyethylene.

2.4 BRANCH CIRCUIT CONTROLLER (BCC)

A. Branch Circuit Controller Components:

1. Casing: Galvanized Steel housing liquid-gas separator and multiple refrigeration control valves. The casing shall house two tube-in-tube heat exchangers.
2. Refrigerant valves: The unit shall be furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH. Branches may be twinned to allow more than 54,000 BTUH.
 - a. Each branch shall have multiple two-position valves to control refrigerant flow.
 - b. Service shut-off valves shall be field-provided/installed for each branch.
 - c. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
3. Integral Drain Pan: An integral condensate pan and drain shall be provided.
4. Electrical: The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
 - a. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).

5. The BC Controller shall be controlled by integral microprocessors connected to the system control network.
 - a. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.5 ACCESSORIES

- A. Control equipment and sequence of operation are shown on the drawings and specified in Section 230900 "Instrumentation and Control for HVAC.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. Additional Monitoring:
 1. Monitor constant and variable motor loads.
 2. Monitor variable-frequency-drive operation.
 3. Monitor economizer cycle.
 4. Monitor cooling load.
 5. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- B. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 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. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. Alpha Wire.
 - 3. Belden Inc.
 - 4. Encore Wire Corporation.
 - 5. General Cable Technologies Corporation.
 - 6. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. IlSCO; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 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 NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.

- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. 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.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to building code requirements.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. 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.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.4 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Burndy; Part of Hubbell Electrical Systems.
 2. Dossert; AFL Telecommunications LLC.
 3. ERICO International Corporation.
 4. Fushi Copperweld Inc.
 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
 6. Harger Lightning and Grounding.
 7. ILSCO.
 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
 9. Robbins Lightning, Inc.

10. Siemens Power Transmission & Distribution, Inc.

2.2 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.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

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.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. 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.

3.2 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 and ground buses.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. 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.

3.4 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. Ground Rods: Drive rods until tops are 2 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.
- C. 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.

D. 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.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.5 FIELD QUALITY CONTROL

A. 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.

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 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 that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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 the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
- B. Shop Drawings: 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. Equipment supports.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

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.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Atkore International.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. 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-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated 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.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
2. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
3. Toggle Bolts: All-steel springhead type.
4. Hanger Rods: 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.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized 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.
- D. 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 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. 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.
- D. Mounting and Anchorage of Surface-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.
 - 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted 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 substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Surface raceways.
 - 4. Boxes, enclosures, and cabinets.
 - 5. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Anamet Electrical, Inc.
 - 4. Electri-Flex Company.
 - 5. O-Z/Gedney.
 - 6. Picoma Industries.

7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube 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. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- I. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corporation.
 6. Condux International, Inc.
 7. Electri-Flex Company.
 8. Kraloy.

9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; Hubbell.
12. Thomas & Betts Corporation.

- B. Listing and Labeling: Nonmetallic 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. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: Comply with UL 514B.
- G. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. [Manufacturer's standard enamel finish in color selected by Architect] [Prime coated, ready for field painting].
 1. Manufacturers: Subject to compliance with requirements, [provide products by the following:
 - a. Wiremold / Legrand.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
 7. Hubbell Incorporated.
 8. Kraloy.
 9. Milbank Manufacturing Co.
 10. Mono-Systems, Inc.
 11. O-Z/Gedney.
 12. RACO; Hubbell.
 13. Robroy Industries.
 14. Spring City Electrical Manufacturing Company.
 15. Stahlin Non-Metallic Enclosures.
 16. Thomas & Betts Corporation.
 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- I. Gangable boxes are allowed.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Oldcastle Precast, Inc.
 - e. Quazite: Hubbell Power System, Inc.
 - f. Synertech Moulded Products.
 2. Standard: Comply with SCTE 77.
 3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 6. Cover Legend: Molded lettering, "ELECTRIC."
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION**3.1 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: RNC, Type EPC-40-PVC.
 2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
 3. Underground Conduit: RNC, Type EPC-40-PVC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: IMC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch trade size.
- D. 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. EMT: Use setscrew or compression fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install surface raceways only where indicated on Drawings.

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. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- L. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. 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.
- R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- U. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. 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.

- V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Y. Locate boxes so that cover or plate will not span different building finishes.
- Z. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with building code requirements.

3.5 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 26 05 33

SECTION 26 0544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Round sleeves.
 2. Rectangular sleeves.
 3. Sleeve seal systems.
 4. Grout.
 5. Pourable sealants.
 6. Foam sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Wall Sleeves, Steel:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, LLC.
 - b. CCI Piping Systems.
 - c. Flexicraft Industries.
 - d. GPT; an EnPro Industries company.
 2. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.
- B. Pipe Sleeves, PVC:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CCI Piping Systems.
 - b. GPT; an EnPro Industries company.

- c. Metraflex Company (The).
2. Description: ASTM D1785, Schedule 40.
- C. Sheet Metal Sleeves, Galvanized Steel, Round:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Benefast.
 - b. Specified Technologies, Inc.
 2. Description: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

- A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Abesco Fire LLC.
 - b. Specified Technologies, Inc.
 - c. Wiremold; Legrand North America, LLC.
 2. Description:
 - a. Material: Galvanized sheet steel.
 - b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16 inch, thickness must be 0.052 inch.
 - 2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16 inch, thickness must be 0.138 inch.

2.3 SLEEVE SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, LLC.
 2. CALPICO, Inc.
 3. Flexicraft Industries.
 4. Metraflex Company (The).
 5. Proco Products, Inc.

- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
 - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 - 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

- A. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.6 FOAM SEALANTS

- A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING – Section 26 0544

- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION – 26 0544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Underground-line warning tape.
 - 2. Warning labels and signs.
 - 3. Equipment identification labels.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.4 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 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

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. Warning label and sign shall include, but are not limited to, the following legends:

1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

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. 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 exceeds 16 inches overall.
- F. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- B. 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.
- C. 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.
- D. 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.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: [Adhesive film label] [Adhesive film label with clear protective overlay] [Self-adhesive, engraved, laminated acrylic or melamine label] [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.

- b. Outdoor Equipment: Stenciled legend 4 inches high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. 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.
2. Equipment to Be Labeled:
- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Switchgear.
 - d. Enclosed switches.

END OF SECTION 26 05 53

SECTION 26 24 16 - PANELBOARDS

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. Lighting and appliance branch-circuit panelboards.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective 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 bus configuration, current, and voltage ratings.
 3. Short-circuit current rating of panelboards and overcurrent protective devices.

1.4 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. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 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 type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI Types: Two spares for each panelboard.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. 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.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations:
 1. 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.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 1. Ambient temperatures within limits specified.
 2. Altitude not exceeding 6600 feet.
- C. 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 Architect and NPS no fewer than two days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Architect's or NPS written permission.
3. Comply with NFPA 70E.

1.9 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.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage 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 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Surface-mounted cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
 5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Finishes:
 - a. Panels 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.

- b. Back Boxes: Galvanized steel.
- 7. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Compression type.
 - 3. Ground Lugs and Bus-Configured Terminators: Compression type.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. 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.
 2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - d. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
 3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

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.
- B. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- C. 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.
- D. Install overcurrent protective devices and controllers not already factory installed.
- E. Install filler plates in unused spaces.
- F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- G. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. 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.
- 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.

3.5 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 262713 - ELECTRICITY METERING

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 equipment for electricity metering by utility company.

1.3 DEFINITIONS

- A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
- B. PC: Personal computer.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

1.8 PROJECT 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 Architect and NPS no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architect's or NPS written permission.

1.9 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power services.
 - 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Meters will be furnished by utility company.
- B. Meter Sockets: Comply with requirements of electrical-power utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
- C. Electricity metering will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 26 27 13

SECTION 26 27 26 - WIRING DEVICES

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. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Weather-resistant receptacles.
 - 3. Snap switches.
 - 4. Communications outlets.

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 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 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.

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. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand (Pass & Seymour).
- 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. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), CR5362 (duplex).
 - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGF20.
 - b. Hubbell; GFR5352L.
 - c. Pass & Seymour; 2095.
 - d. Leviton; 7590.

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Single Pole:
 - 2) Cooper; AH1221.
 - 3) Hubbell; HBL1221.
 - 4) Leviton; 1221-2.
 - 5) Pass & Seymour; CSB20AC1.

2.6 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6252.
 - b. Hubbell; DR15.
 - c. Leviton; 16252.
 - d. Pass & Seymour; 26252.

B. Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TWRBR15.
 - b. Hubbell; DR15TR.
 - c. LevitonTRW15.
 - d. Pass & Seymour; TRW26252.

2. Description: Labeled to comply with NFPA 70, "Receptacles, Cord Connectors, and Attachment Plugs (Caps)" Article, "Tamper-Resistant Receptacles in Dwelling Units" Section, when installed in wet and damp locations.

- C. GFCI, Non-Feed-Through Type, Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGF15.
 - b. Hubbell; GF15LA.
 - c. Leviton; 8599.
 - d. Pass & Seymour; 1594.

- D. GFCI, Tamper-Resistant and Weather-Resistant Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; TWRVGF15.
 - b. Hubbell; GFTR15.
 - c. Pass & Seymour; 1594TRWR.

- E. Toggle Switches, Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 7621 (single pole), 7623 (three way).
 - b. Hubbell; DS115 (single pole), DS315 (three way).
 - c. Leviton; 5621-2 (single pole), 5623-2 (three way).
 - d. Pass & Seymour; 2621 (single pole), 2623 (three way).

2.7 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
 3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.8 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

2.9 FINISHES

- A. Device Color:
1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. 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.
- C. 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.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. 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 in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. 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.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

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. 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.
- C. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES**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. Cartridge fuses rated 600-V ac and less for use in enclosed switches.
 - 2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Coordination charts and tables and related data.

1.5 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.6 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, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.7 PROJECT CONDITIONS

- 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.

1.8 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

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. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 2. Finish: Gray, baked enamel.
 3. Identification: "SPARE FUSES" in 1-1/2-inch high letters on exterior of door.
 4. 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 1. Service Entrance: Class RK1, fast acting.
 2. Feeders: Class RK1, time delay.
 3. Other Branch Circuits: Class RK5, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet.

END OF SECTION 26 28 13

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Shunt trip switches.
 - 4. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

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, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.6 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Fuse Pullers: Two for each size and type.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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.
- D. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

- A. 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 Architect and NPS no fewer than seven 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 Architect's or NPS written permission.
 4. Comply with NFPA 70E.

1.9 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. 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. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240-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.

2.3 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc.
 2. Ferraz Shawmut, Inc.

3. Littelfuse, Inc.

- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- E. Accessories:
 - 1. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 2. Form C alarm contacts that change state when switch is tripped.
 - 3. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.
 - 4. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 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.

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. Install fuses in fusible devices.

- C. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "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 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 enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. 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.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16

SECTION 31 01 01 SITE RESTORATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Bidding Requirements, Contract Conditions, and Division 1 Specification Sections in their entirety apply to this Section.

1.2 DESCRIPTION OF WORK

- A. This work shall consist of rough-grading, placing and leveling topsoil materials to the grades and lines specified on the plans, and planting grass seed.
- B. Related work specified elsewhere:
 - 1. 01 35 92 Special Procedures Archaeological

1.3 QUALITY ASSURANCE

- A. Provide prepackaged seed readily available to the public with quality and purity equal to product of O.M. Scotts and Son, Marysville, OH 43041. On-the-job or made-to-order mixes will not be accepted.

1.4 DELIVERY STORAGE AND HANDLING

- A. Deliver fertilizer in manufacturer's standard size bags or cartons showing weight, analysis, and the name of the manufacturer. Store as approved by Director's Representative.
- B. Store all seed at the site in a cool dry place as approved by the Director's Representative. Replace any seed damaged during storage.

1.5 SCHEDULING

- A. Time For Seeding: Sow grass seed between April 1 and May 15th or between August 15th and October 15th, except as otherwise approved in writing by the Architect.

PART 2 PRODUCTS

2.1 TOPSOIL

- A. Source: Provide topsoil from existing stockpiles stripped from the project site and approved by the Architect.
- B. Provide topsoil conforming to the following:
 - 1. Original loam topsoil, well drained homogeneous texture and of uniform grade, without the admixture of subsoil material and entirely free of

- dense material, hardpan, sod, or any other objectionable foreign material.
- 2. Containing not less than 4 percent nor more than 20 percent organic matter in that portion of a sample passing a 1/4 inch sieve when determined by the wet combustion method on a sample dried at 105 degrees C.
- 3. Containing a Ph value within the range of 4.5 to 7 on that portion of the sample that passes a 1/4 inch sieve.
- 4. Containing the following gradations:

SIEVE DESIGNATION	PERCENT PASSING
1 inch	100
1/4 inch	97 - 100
No. 200	20 - 65 (of the 1/4 inch sieve)

2.2 FERTILIZER

- A. Fertilizer: Mixed commercial fertilizers shall contain total nitrogen, available phosphoric acid and soluble potash in the ratio of 10-6-4 (50% N/UF). 50% of total nitrogen shall be derived from ureaform furnishing a minimum of 3.5% water insoluble nitrogen (3.5% WIN). The balance of the nitrogen shall be present as methylene urea, water-soluble urea, nitrate and ammoniacal compounds.

2.3 SEED

- A. Furnish fresh, clean, new-crop seed mixed in the proportions specified for species and variety, and conforming to Federal and State Standards.
- B. Acceptable material in a seed mixture other than pure live seed consists of nonviable seed, chaff, hulls, live seed of crop plants and inert matter. The percentage of weed seed shall not exceed 0.1 percent by weight.
- C. All seed will be rejected if the label indicates any noxious weed seeds.
- D. Provide seed mixture equal to Scotts Pure Premium Sun and Shade North Grass Seed Mixture, comprised of the following:

SEED MIXTURE			
AMOUNT BY WEIGHT IN MIXTURE	SPECIES OR VARIETY *	PERCENTAGE	
		PURITY	GERMINATION
30 PERCENT	FENWAY RED FESCUE	97 PERCENT	80 PERCENT
30 PERCENT	ABBAY KENTUCKY BLUEGRASS BLEND	95 PERCENT	80 PERCENT
20 PERCENT	DEVINE PERENNIAL RYE	98 PERCENT	85 PERCENT
20 PERCENT	ENCHANTED PERENNIAL RYE	98 PERCENT	85 PERCENT
100 PERCENT			

*Variety may be altered depending on availability of seed from manufacturer.

2.4 MULCH

- A. Dry Application, Straw: Stalks of oats, wheat, rye or other approved crops that are free of noxious weed seeds. Weight shall be based on a 15 percent moisture content.

PART 3 EXECUTION

3.1 GRADING

- A. Rough Grading: Trim and grade lawn areas within the Contract Limit to a level of 4 inches below the finish grades indicated unless otherwise specified herein or where greater depths are indicated. Provide smooth uniform transition to adjacent areas.
- B. Finish Grading: Finish surfaces free from irregular surface changes, and as follows:
 - 1. Grassed Areas: Finish areas to receive topsoil to within 1 inch above or below the required subgrade surface elevations.

3.2 SPREADING TOPSOIL

- A. Perform topsoil spreading operations only during dry weather.
- B. To insure a proper bond with the topsoil, harrow or otherwise loosen the subgrade to a depth of 3 inches before spreading topsoil.
- C. Spread topsoil directly upon prepared subgrade to a minimum depth measuring 4 inches after natural settlement in areas to be seeded. Slope grade away from building, at minimum 1/8" per linear foot slope. Smooth out unsightly variations, bumps, ridges, and depressions that will hold water. Remove stones, litter, or other objectionable material. Finished surfaces shall conform to the contour lines and elevations indicated on the drawings or fixed by the Architect.

3.3 PREPARATION FOR SEEDING

- A. Seed Bed: Scarify soil to a depth of 2 inches in compacted areas. Smooth out unsightly variations, bumps, ridges, and depressions that will hold water. Remove stones, litter, or other objectionable material.
- 3.4 FERTILIZING
- A. Apply 10-6-4 fertilizer evenly at the rate of 40 pounds per 1000 sq ft .
- 3.5 SEEDING
- A. Assume all risks when seed is sowed before approval of seed analysis.
 - B. Do not seed when the wind velocity exceeds 5 miles per hour.
 - C. Application Rate: 8 pounds per 1000 sq ft.
 - D. Dry Application: Sow seed evenly by hand or seed spreader on dry or moderately dry soil.
- 3.6 MULCHING
- A. Dry Application: Within 3 days after seeding, cover the seeded areas with a uniform blanket of straw mulch at the rate of 50 pounds per 1000 sq ft of seeded area.
- 3.7 LAWN ESTABLISHMENT
- A. Maintain the grass at heights between 2-1/2 inches and 3-1/2 inches and include a minimum of 2 mowings.
 - B. Water and protect all seeded areas until final acceptance of the lawn.
- 3.8 FINAL ACCEPTANCE
- A. Final acceptance of seeded areas will be granted when a uniform stand of acceptable grass is obtained, with a minimum of 95 percent coverage. Portions of the seeded areas may be accepted at various times at the discretion of the Architect.
 - B. Unacceptable seeded areas, dry application: Reseed as specified and fertilized at one-half the specified rate.
 - C. Once accepted, the Owner will assume all maintenance responsibilities.

END OF SECTION

SECTION 32 92 19 SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide seeded lawns as shown including any disturbed areas. Work includes:
 - 1. Soil preparation
 - 2. Soil amendments
 - 3. Maintenance
 - 4. Protection stakes and roping.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified turfgrass Installer whose work has resulted in successful turf grass establishment.
- B. Professional Membership: Installer shall be a member in good standing of one of the following: The Professional Landcare Network, the State or National Nursery and Landscape Association, or the State Turfgrass Foundation.
- C. Experience: Five years' experience in turf seeding installation.
- D. Installer's Field Supervision: Installer to maintain an experienced full-time supervisor on project site when work is in progress.
- E. Maintenance Proximity: Not more than two hour's normal travel time from Installer's place of business to project site.
- F. Pesticide Applicator: State commercial licensed.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.
 - 2. Certification of Grass Seed: From seed vendor for each grass-seed mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 3. Supply National Turfgrass Evaluation Program (NTEP) data for each species to be used.
 - a. Qualification Data: For qualified turf and grass Installer.
 - b. Product Certificates: For fertilizers from manufacturer.
 - c. Material Test Reports: For standardized ASTM D 5268 topsoil.

1.4 PROJECT CONDITIONS

- A. Perform seeding work only after planting and other work affecting ground surface has been completed.
- B. Provide hose and lawn watering equipment as required.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.
- D. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Ohio Historical Connection's operations and others in proximity to the Work. Notify Ohio Historical Connection before each application is performed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver seed and fertilizer materials in original unopened packages or containers, showing weight, certified analysis, and name, telephone and address of manufacturer, and indication of conformance with state and federal laws as applicable. Store in a manner to prevent wetting and deterioration.
- B. Store materials at site in an orderly manner at location acceptable to the Architect.
- C. Bulk materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas and planting beds.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

1.6 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of seeding Installer. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:
 - 1. Seeded Turf: 60 days from date of Substantial Completion.
 - 2. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

1.7 WARRANTY

- A. Provide a uniform stand of grass by watering, mowing, and maintaining seeded areas until final acceptance. Reseed areas, with specified materials, which fail to provide a uniform stand of grass until all affected areas are acceptable to the Architect.

PART 2 - PRODUCTS**2.1 MATERIALS**

- A. Lawn (grass) seed: Fresh, clean, and new crop seed mixture complying with AOSA’s “Journal of Seed Technology: Rules for Testing Seeds” for purity and germination tolerances. Each seed type certified.
 - 1. Mixed by an approved method.
 - 2. Composed of improved varieties of local seed types suitable for job specific solar exposure, wear ability and disease resistant. Mix to approved proportions by weight and tested to maximum percentages of purity and germination. Seed to be free of noxious weed and other locally unacceptable grass seed types.
 - 3. Test for germination made within preceding six months. Not to exceed 0.25% weed seed. Seeding rates shall be determined by the percent pure live seed, where $PLS = \% \text{ pure seed} \times \% \text{ germination} \times 100$.
- B. Blends:
 - 1. Seed mixtures noted on the planting plan.
- C. Fertilizer:
 - 1. Granular or pelletized, guaranteed analysis professional fertilizer composed of non-burning products composed of not less than 50% organic slow acting water-insoluble nitrogen, phosphorous, and potassium.
 - a. Composition: 1 part nitrogen, 2 parts phosphorous, and 1 part potassium (NPK 1:2:1) or similar approved composition generally accepted by local nursery trade.
- D. Mulch: Green dyed wood cellulose or wood fiber mulch such as Conwed Hydromulch, Weyerhaeuser Silva-Fiber or clean fresh straw if acceptable to Ohio Historical Connection.
- E. Water: Free of substance harmful to seed growth. Hoses or other methods of transportation furnished by Contractor.
- F. Protection Stakes/Roping: 2 x 2 hardwood stakes 54” long with pencil-sharpened bottom. Drill 3/8” diameter hole 11/2” from the top. Stakes to be painted white. Roping 1/4” diameter solid braid white nylon.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by seeding operations.
- B. Protect adjacent and adjoining areas from hydro mulching overspray.
- C. Protect grade stakes set by others until directed to remove them.

- D. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- E. Verify limits of each type of lawn material with the Architect in the field before starting lawn work. Limit preparation of seed areas to those ready for immediate seeding.
- F. Grade lawn areas to a smooth, free draining even surface with a loose, moderately coarse texture. Roll, scarify, rake, and level as necessary to obtain true, even lawn surfaces and fill depressions as required to drain. Correct all surface irregularities resulting from tillage operations to prevent formation of depressions or water pockets. Seedbed is to be established at approximately 1/2" below all curbs, pavements and sidewalks.
- G. Cultivate topsoil to provide a firm bed a minimum of 4" deep, free of clods, plastic containers, concrete chunks, brickbats, sticks, roots, rubbish, or other foreign matter. Remove all stones and rocks so that sparse amounts of stones no more than 1" in diameter remain within the top 4" of the topsoil. Do not move heavy objects except necessary lawn making equipment over the lawn areas after the soil is prepared unless it is again loosened and graded. Level all undulations or irregularities in the surface.
- H. Apply fertilizer to all turf areas at a rate equal to 2.0 lbs. of actual phosphorous (P) per 1,000 sq. ft., or as directed by the Architect.
- I. Apply fertilizers by mechanical rotary or drop type distributor, thoroughly and evenly incorporated in to the soil to a depth of 1"-2" by dicing or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.
- J. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to seeding.

3.2 INSTALLATION

- A. Seeding:
 - 1. Seed immediately after preparation of bed. Seed during periods generally accepted by the local nursery trade for the specific seed blend. Seeding times other than those locally recognized shall be acceptable to the Architect.
 - 2. Seed indicated areas within contract limits and areas adjoining contract limits disturbed as a result of construction operations.
 - 3. Perform seeding operations when the soil is dry and when winds do not exceed five miles per hour velocity.
 - 4. Seed to be applied at approved minimum rates in cross directions with approved seed drilling or slice seeding equipment. Apply 50% of the seed in each direction. Seed applied by hydro-seeding methods is unacceptable.
 - 5. Apply hydro-mulch with approved hydro-mulching equipment immediately after seeding. Slurry to be composed of clean water and mulch. Apply mulch slurry at a minimum rate of 1,500 pounds to 2,000 pounds per acre on slopes steeper than 4:1. Direct slurry to evenly cover designated seed areas. Repair ruts, depressions and all damage caused by hydro-mulching equipment. If straw is

applied, the layer is not to be too thick which will inhibit seed germination. Immediately remove any excess straw or straw piles.

6. Immediately re-seed and re-apply hydro-mulch and/or straw to areas that show poor germination.

B. During germination period, protect and water seeded areas, maintain top 1/2" to 1" soil constantly moist. Continue watering for minimum of four weeks.

3.3 MAINTENANCE

A. Maintain newly seeded lawns until completion and acceptance of the entire construction project.

B. Maintain newly installed seeded lawn areas in an acceptable manner including watering, top dressing, spot weeding, mowing, trimming, removal of clippings, leaf removal, applications of herbicides, fungicides, insecticides, and re-seeding. Apply post-emergent herbicides (selective and non-selective) only as necessary to treat already germinated weeds and in accordance with manufacture's written recommendations.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Keep turf uniformly moist to depth of 4 inches.
2. Water turf with a fine spray nozzle to apply a minimum of 1 inch per week of water unless rainfall precipitation is adequate.
3. Repair, re-work, re-seed, and re-mulch all respective areas that have settled, washed out, were disturbed by wind, are eroded, did not germinate, or were damaged by maintenance operations.
4. Set mower blades at a minimum height of 3". Not more than 30% of the grass leaf/blade shall be removed at the initial or subsequent mowing. Mow all lawns before turf reaches a height of 4". Do not mow grass when wet.
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 Architect.

3.4 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by seeding work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. During the grow-in period, drive protection stakes into the ground until 36" remains above finish grade. Place stakes at 8' o/c with protection roping threaded thru stake hole and strung between each stake. Provide a continuous stake/roping system for all areas subject to foot traffic to protect the seed until full establishment. Remove stake/roping system after the grass is established.

3.5 ACCEPTANCE

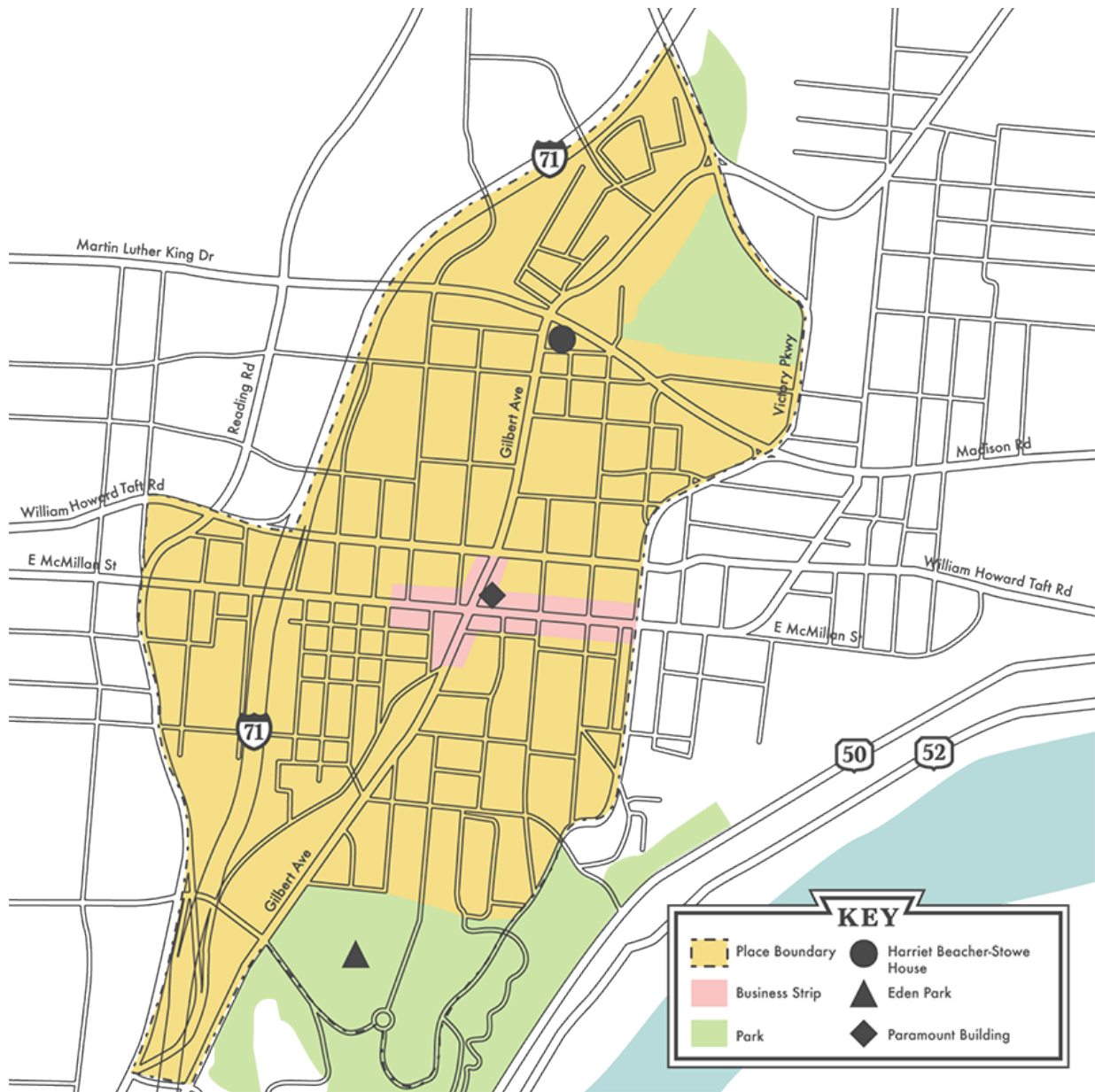
- A. Inspection to determine acceptance of installed lawns will be made by the Architect, upon Contractor's request. Provide notification at least five (5) working days before requested inspection date.
 - 1. New lawn areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy uniform, close stand of the specified 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 2% of the individual areas, in those areas requested for inspection.

- B. Upon acceptance, the Ohio Historical Connection will assume lawn maintenance.

END OF SECTION 32 92 19

Appendix 1

PBE District and SMSA Maps



Ohio Metropolitan Statistical Areas (MSAs)

Developed by the United States Office of Management and Budget, Metropolitan Statistical Areas are integrated geographic regions comprised of at least one city or urban area (with a population of at least 50,000) and adjacent communities. Metropolitan Statistical Areas make it possible for federal statistical agencies to utilize the same boundaries when publishing statistical data.



- | | | |
|---|--|---|
| <p>A. Akron MSA
 B. Canton-Massillon MSA
 C. Cincinnati MSA,
 including Dearborn, Ohio, and Union
 Counties in Indiana; Boone, Bracken,
 Campbell, Gallatin, Grant, Kenton, and
 Pendleton Counties in
 Kentucky
 D. Cleveland-Elyria MSA
 E. Columbus MSA</p> | <p>F. Dayton MSA
 G. *Huntington-Ashland MSA,
 including Boyd and Greenup Counties in
 Kentucky; Cabell, Lincoln, Putnam, and
 Wayne Counties in West Virginia
 H. Lima MSA
 I. Mansfield MSA
 J. Springfield MSA
 K. Toledo MSA</p> | <p>L. *Weirton-Steubenville MSA,
 including Brooke and Hancock Counties
 in West Virginia
 M. *Wheeling MSA, including
 Marshall and Ohio Counties in West
 Virginia
 N. Youngstown-Warren-Boardman MSA,
 including Mercer County in
 Pennsylvania</p> |
|---|--|---|

*Data on West Virginia MSAs including Ohio counties may be viewed at <http://workforcewv.org/lmi/>.

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