INVITATION TO BID

BID #2018-37

Coliseum Elevator Addition

Mailing Address: Office of the City Clerk
City of Bloomington
109 East Olive Street
Bloomington, IL 61701

Contact Person(s): Russel Waller
Facility Manager
rwaller@cityblm.org

Carla Murillo
Procurement Manager
cmurillo@cityblm.org
309-434-2277

Bids Due: Thursday, March 22, 2018 at 10:00 a.m. Central Time
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LEGAL NOTICE OF
INVITATION TO BID
CITY OF BLOOMINGTON, ILLINOIS

Sealed bids will be received at the office of the City Clerk, City Hall, 109 East Olive Street, Bloomington, Illinois 61701, until March 22, 2018 at 10:00 a.m. Central time, at which time they will be publicly opened and read for the following:

BID #2018-37

COLISEUM ELEVATOR ADDITION

A pre-bid meeting/site visit will be held on March 7, 2018 at 10:00 a.m. central time, at 205 S. Roosevelt Street, Bloomington, Illinois, 61701. It is highly suggested that interested parties attend. This is the only time scheduled for a site visit.

Bid documents are to be obtained from the City of Bloomington Procurement Services by sending an email to procurement@cityblm.org. Respondents must provide their complete name, company name, street address, telephone number, fax number and their email address. Bid documents may also be obtained at the office of the City Clerk, Monday through Friday between the hours of 8:00 a.m. and 5:00 p.m. Central time. Only contractors recorded with the City, as a bona fide plan holder, are eligible for the contract award.

The City of Bloomington reserves the right to reject any and all bids and to waive technicalities.

The City of Bloomington requires all contractors doing business with the City not to discriminate on the basis of race, age, color, religion, gender, ancestry, national origin, marital status, mental or physical disability unrelated to ability, familial status or sexual orientation.

Bid must be accompanied by a Bid guaranty which shall not be less than five percent (5%) of the amount of the Bid. The successful bidder will be required to provide Performance and Payment Bonds in the amount equal to 100% of the contract price, within ten (10) business days after the bid award.

Contractors shall not pay less than the prevailing rates of wages to all laborers, workmen, and mechanics performing work under this contract, and shall comply with the requirements of the Illinois Prevailing Wage Act (820 ILCS 130/1-12).

Carla Murillo, Procurement Manager

Published February 28, 2018 Bloomington, Illinois
TERMS AND CONDITIONS FOR BIDDERS

BACKGROUND: The City of Bloomington, incorporated in 1856, is a home rule unit of government under the 1970 Illinois Constitution. The City of Bloomington is located in the heart of Central Illinois, approximately 125 miles southwest of Chicago, 155 miles northeast of St. Louis and 64 miles northeast of Springfield, the State Capital. The City of Bloomington is the County Seat of McLean County, the largest county in Illinois (approximately 762,240 acres). The results of the 2010 Census shows the City now has a population of 76,610 citizens. The economic strength of the City of Bloomington metropolitan area is well diversified with no single dominating industry.

BID IDENTIFICATION: Bidders are required to legibly write the bid number, bid name and due date in the lower left corner. Do not submit bids by fax or electronically. Bids submitted by fax or electronically cannot be accepted or considered for award. Sealed bids are required.

DEFINITION: "City" shall mean the City of Bloomington, Illinois.

QUESTIONS: Questions regarding bid/proposal procedures shall be directed to Jon Johnston, Procurement Manager, during regular working hours, telephone 309-434-2333.

Questions regarding the technical nature or performance expectations of the equipment, material, or service in the bid shall be submitted in writing to:

    Russel Waller, Facility Manager, at rwaller@cityblm.org
    and
    Misty Shafer, Procurement Specialist, at mshafer@cityblm.org or
    Fax (309) 434-2874

Questions will be answered in the form of written addenda and provided to all Bidders, as per State of Illinois statutes.

BID PACKAGE: If you have obtained this bid from the City of Bloomington web site or from a source other than directly from Procurement Services or the City Clerk, you are not on record as a plan holder. The Procurement Office takes no responsibility to provide addenda to parties not listed by the City as plan holders. It is the bidder’s responsibility to check with the Procurement Office, or with the City Clerk’s office prior to submitting your bid to ensure that you have a complete, up-to-date package. The original bid document maintained and on file in the City Clerk’s office shall be considered the official “copy”. Copies of all addenda shall be attached to the bid document as proof of receipt.

One original and 2 copies of the complete bid packet should be submitted to:
    Bloomington City Clerk’s Office
    109 E. Olive Street
    Bloomington, Illinois 61701

REJECTION OF BIDS: The City of Bloomington reserves the right to reject any and all bids and to waive technicalities and to accept that bid which is to be considered to be in the best interest of the City. Any such decision shall be considered final.

BID SUBMISSION: Submit (1) original and 2 copies of the entire bid packet
**NON-DISCRIMINATION:** The City of Bloomington requires all contractors doing business with the City not to discriminate against anyone on the basis of race, age, color, religion, gender, ancestry, national origin, marital status, mental or physical disability unrelated to ability, familial status or sexual orientation.

Contractors shall comply with the Illinois Human Rights Act, 775 ILCS 5/101 et seq., as amended and any rules and regulations promulgated in accordance therewith, including, but not limited to the Equal Employment Opportunity Clause, Illinois Administrative Code, Title 44, Part 750 (Appendix A), 775 ILCS 5/1-102 and constituting of a written EEO policy and a workforce profile that demonstrates its EEO practices. Furthermore, the Contractor shall comply with the Public Works Employment Discrimination Act, 775 ILCS 10/0.01 et seq., as amended. The contractor must have a written sexual harassment policy, which meets Illinois Compiled State Statutes, 775 ILCS, 15/3.

**EX PARTE COMMUNICATION:** Please note that to insure the proper and fair evaluation of a proposal or bid, the City of Bloomington prohibits ex parte communication (i.e., unsolicited) initiated by the Bidder to a City Official (i.e. City Aldermen, Mayor, etc.) or Employee evaluating or considering the proposal/bid prior to the time a selection has been made. Communication includes but is not limited to fax, phone calls, email and personal visit. Communication between Bidder and the City shall be directed in writing to the Purchasing Agent or designated contact person only. The Purchasing Agent will obtain the information or clarification needed. Ex parte communication may be grounds for disqualifying the offending Bidder from consideration or award of the proposal and repeat offenders may be disqualified from future projects.

**NO BID:** Contractors who are not able to submit a bid for this service, but wish to receive bid tabulation or to be assured of remaining on the City’s bid list for similar services should clearly indicate on the envelope the designation “NO BID”. Envelopes so marked will not be considered as a formal bid, but the contents will be responded to in the appropriate manner by City of Bloomington staff. The City will issue a purchase order to the successful Contractor.

**DELIVERY:** F.O.B. Bloomington, IL FREIGHT PREPAID. Delivery will be considered in making the award and the bidders shall state, in the spaces provided, expected delivery after receipt of Purchase Order. Failure to meet said delivery promises without prior consent of the City Procurement Manager may be considered a breach of faith.

**FULL PRICING AND CONTINGENCIES:** Please quote your best net price including delivery and discounts to meet the approval of the City. Prices shall be stated in units of quantity specified. No additional charges shall be passed to the City, including any applicable taxes, delivery or surcharges. Prices quoted shall be the final cost to the City. The City shall hold the successful bidder to the bid pricing. Additional charges for contingencies discovered by the bidder at any time after the date of the opening of this bid may not be considered for payment by the City. All prices and notations shall be in ink or typewritten. Mistakes may be crossed out and corrections made in ink and must be initialed and dated in ink by the person signing the bid. In case of error in the extension of prices, the unit price shall govern.

**PAYMENT TERMS:** If payment terms are not indicated, terms of NET 30 days shall be applied by the City. Payment terms to apply after receipt of invoice or final acceptance of the products/services, whichever is later. Payment terms offering less than 20 days for payment will not be considered.
**BID EVALUATION:** Bids will be evaluated and awarded to the lowest responsible, responsive bidder. The quality of the products/services, conformity with the specifications, suitability to the requirements, delivery terms including length of time for delivery, qualifications and references will be taken into consideration in making an award. The City will be the sole judge of acceptability of any products offered.

**QUALITY:** The scope of work or specification is intended to procure a quality product or service. Quality must be proven to the satisfaction of the City to meet or exceed requirements as set forth in the scope of work. Items shall be manufactured according to the highest traditions of the industry and shall meet all commercial standards of quality. The City will be the sole judge of acceptable products. Unacceptable products will be rejected and suitable price adjustments be made.

It is the bidder’s task to be familiar with the referenced items and to offer only products of equal or greater quality. Samples, when requested, must be furnished free of expense, and upon request, if not destroyed, may be returned at the Bidder’s risk and expense.

**RECOUSE FOR UNSATISFACTORY MATERIALS:** Payment shall be contingent upon the City’s inspection of and satisfaction with completed work. Any defective work or materials, non-conformance to bid specifications, damaged materials, or unsatisfactory installation shall be corrected to the City’s satisfaction by the successful bidder at no additional charge.

**INVESTIGATION:** Bidders must acquaint themselves with the policies of the City, and may do so by contacting the Procurement Manager. All questions as to the meaning of the scope of work must be resolved prior to the bid submission deadline. It is the Bidder’s responsibility to check with City Clerk prior to submitting their bid to ensure that they have received all Addenda issued.

**PROOF OF LICENSE, PERMIT, ETC.:** Bidders must provide proof of conformance with any applicable Federal/State/Local permits, licenses, certifications, etc., or the ability to obtain any applicable Federal/State/Local permits, licenses, certifications, etc., within a reasonable time after the bid award and prior to the performance of the work. It is the bidder’s responsibility to inquire about requirements of performing the job with the requesting department contact person.

**BID FORM:** This entire package shall be returned complete and intact with all information requested and all questions answered. Failure to do so may be considered grounds for rejection of the bid. The amount of the bid shall be stated on the form(s) provided. Variations from the Specification shall be noted on a separate sheet of paper. If more space is required to furnish a description of the service offered or delivery/start terms, the contractor may attach a letter hereto, which will be made a part of the bid.

**SPECIFICATION:** The Specification may, in some areas, be unique to a particular brand of product or type of service. If this situation exists, equal consideration will be given to all Bidders whose items, in the opinion of the City, meets or exceeds performance in these areas.

**ALTERNATES:** Trade names are used solely for the purpose of setting minimum standards of quality and performance and are not to be construed as exclusionary. Bidders are encouraged to contact the City Purchasing Department prior to the bid opening for the purpose of clarifying specifications.
**BRAND NAME, MODEL, SCOPE OF WORK:** All Bidders shall include with their bid brand names, models, catalog numbers, and complete information about the items they are offering. Manufacturer's Safety Data Sheets, MSDS, are required for all chemical Bids. Failure to do so may be considered grounds for rejection of the bid.

**DEFAULT BY CONTRACTOR:** In the event of default by contractor, the City reserves the right to procure the services from other sources, and hold the contractor liable for any excess costs occasioned thereby. Additionally, a contract shall not be assignable by the Contractor in whole or in part without the written consent of the City of Bloomington.

**BID OPENING:** Telephone/Fax/Verbal Offers Will Not Be Accepted.
Bids shall be publicly opened and read at the time and date set. It is the responsibility of the contractor to see that the bid is in the Office of the City Clerk, by the specified time and date. The date of the postmark will not be considered. Bids received after the time and date set may be returned unopened to the Contractor. This includes Bids not received as a result of mail delays. In the event that City Hall is closed for business at the time scheduled for the bid opening, sealed bids will be accepted on the next business day of the City, up to the originally scheduled time.

**PERFORMANCE BOND & PAYMENT BONDS:** The successful bidder will be required to provide Performance and Payment Bonds in the amount equal to 100% of the contract price, within ten (10) business days after the bid award. The Performance Bond and Payment Bond shall be duly authorized by a company licensed to do business in the State of Illinois.

**BID BOND:** Bids in excess of $50,000 must be accompanied by a Bid guaranty which shall not be less than five percent (5%) of the amount of the Bid. At the option of the Bidder, the guaranty may be a certified check, bank draft, negotiable U.S. Government Bonds (at par value), or a commonly accepted Bid bond form from a guaranty or surety company. The Bid bond shall be secured by a guaranty or a surety company listed in the latest issue of U.S. Treasury Circular 570. The amount of such Bid bond shall be within the maximum amount specified for such Company in said Circular 570. No Bid will be considered complete unless it is accompanied by the required guaranty. Certified check or bank draft must be made payable to the order of the City. Cash deposits will not be accepted. The Bid guaranty shall insure the execution of the Agreement and the furnishings of the surety bond or bonds by the successful Bidder, all as required by the Contract Documents.

Revised Bids submitted before the opening of Bids, whether forwarded by mail or telegram, if representing an increase in excess of two percent (2%) of the original Bid, must have the Bid guaranty adjusted accordingly; otherwise the Bid will not be considered.

Certified checks or bank drafts, or the amount thereof, Bid bonds, and negotiable U.S. Government bonds of unsuccessful Bidders will be returned as soon as practical after the opening of the Bids.

**CANCELLATION:** Failure to comply with the terms and conditions as herein stated shall be cause for cancellation of the contract. The City will provide a written notice of unsatisfactory performance and the contractor will be allowed adequate time, typically thirty (30) days, to take corrective action and accomplish satisfactory control. If at the end of the stated time to correct, the City may deems that the contractor performance is still unsatisfactory, the contract may be canceled. The exercise of its right of cancellation shall not limit the City’s right to seek any other remedies allowed by law.
WITHDRAWAL OF BID: A contractor may withdraw a bid prior to the deadline for bid submittal by submitting a request for its withdrawal. Bids received after the time for opening bids or received at any place other than the place specified will not be considered. Except as otherwise provided by regulation, all decisions to permit the correction or withdrawal of bids, or to cancel awards or contracts based on bid mistakes, will be submitted in writing and will be supported by a written determination made by the Purchasing Agent.

REJECTION OF BIDS, WAIVERS OF IRREGULARITY: The City reserves the right to reject any or all bids, to waive irregularities, and to accept that bid which is considered to be in the best interest of the City. Any such decision shall be final.

PROTESTS: Any actual or prospective contractor who is aggrieved in connection with this proposal or award may protest to the City Manager within ten (10) days of the award. The protest must be submitted in writing to the Office of the City Clerk immediately after such aggrieved person knows or should have known of the facts.

PREVAILING WAGE: The State of Illinois requires under public works contracts that the general prevailing rate of wages in this locality be paid for each craft or type of worker hereunder. This requirement is in accordance with the Prevailing Wage Act (820 ILCS 130) as amended. This shall include payment of the general prevailing rate for legal holiday and overtime work. It shall be mandatory upon the subcontractor under the Contractor. A copy of the most current monthly prevailing wage rates by County is posted on the Illinois Department of Labor website at www.state.il.us/agency/idol. Note that the Prevailing Wage rates change monthly and it is the contractor’s responsibility to ensure the correct wage is paid.

As a prerequisite of awarding construction contracts in excess of $100,000.00, contractor(s) will provide proof of participation in apprenticeship and training programs approved and registered with the United States Department of Labor’s Bureau of Apprenticeship and Training.

CERTIFIED PAYROLL REQUIREMENTS (Public Act 94-0515): Effective August 10, 2005, contractors and subcontractors on public works projects must submit certified payroll records on a monthly basis to the public body in charge of the construction project along with a statement affirming that such records are true and accurate, that the wages paid to each worker are not less than the required prevailing rate for that County and that the contractor is aware that filing records he or she knows to be false is a Class B misdemeanor. The certified payroll records must include for every worker employed on the public works project, the name, address, telephone number, social security number, job classification, hourly wages paid in each period, number of hours worked each day, and starting and ending time of each work day. These certified payroll records are considered public records and public bodies must make these records available to the public under the Freedom of Information Act, with the exception of the employee’s address, telephone number and social security number. Any contractor who fails to submit a certified payroll or knowingly files a false certified payroll is guilty of a Class B misdemeanor.

SUBSTANCE ABUSE PREVENTION ON PUBLIC WORKS PROJECTS ACT: The successful bidder must be in compliance with the State of Illinois HB-1855 (Public Act 095-0635), which amends the Prevailing Wage Act. Before an employer commences work on a public works project, the employer shall have in place a written program, which meets or exceeds the program requirements in this Act, to be filed with the public body engaged in the construction of the public works and made
available to the general public, for the prevention of substance abuse among its employees. The testing must be performed in a laboratory that is certified for Federal Workplace Drug Testing Programs by the Substance Abuse and Mental Health Service Administration of the U.S. Department of Health and Human Services.

**OSHA REQUIREMENTS:** The Occupational Safety and Health Act of 1970 (OSHA), “guarantees workers the right to a safe and healthful workplace.” Under Section 5(a) (1) of the OSHA Act, the employer must “furnish to each of his employees’ employment and place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to its employees.”

There are times when the City must hire entities and individuals (contractors) to perform services. To this end, contractors hired by the City must perform their duties in a manner that is compliant with all State and Federal health and safety laws and industry guidelines. It is the responsibility of the contractor to ensure that their personnel and subcontractors comply with all State and Federal health and safety laws, regulations and industry guidelines, including, but not limited to those set forth by: OSHA and related regulations, the Safety Inspection and Education Act, the Health and Safety Act, the National Institute of Occupational Safety and Health, the National Fire Protection Association, the Centers for Disease Control, American Industrial Hygiene Association, the American Council of Governmental Industrial Hygienists, the Environmental Protection Agency and the Department of Transportation.

**LOCAL PREFERENCE POLICY:** The City of Bloomington has adopted a Local Preference Purchasing Policy that is applicable in the City’s competitive bidding processes, except in situations where external funding sources do not permit local preference purchasing allowances, in situations where the goods or services being purchased are available through a cooperative purchasing program, or where waived by the City. Bidders should complete the Local Preference Purchasing Policy Certificate if bidder qualifies as a local bidder under the Policy. The Policy is in place to address, in part, responsiveness and related concerns of the City. After submission, but prior to award, an offeror claiming local preference will be required to submit evidence demonstrating all the for local preference are met.

**SECURITY:** The contractor represents and warrants to the City that neither it nor any of its principals, shareholders, members, partners or affiliates, as applicable, is a person or an entity named as a Specially Designated National and Blocked Person (as defined in Presidential Executive Order 13224) and that it is not acting, directly or indirectly, for or on behalf of a Specially Designated or Blocked Person. The contractor further represents and warrants to the City that the contractor and its principals, shareholders, members, partners, or affiliates as applicable, are not directly or indirectly, engaged in, and are not facilitating, the transactions contemplated by this Agreement on behalf of any person or entity named as Specially Designated National and Blocked Person. The contractor hereby agrees to defend, indemnify and hold harmless the City of Bloomington, and all City elected or appointed officials, officers, employees, agents, representatives, engineers and attorneys, from and against any and all claims, damages, losses, risks, liabilities, and expenses (including reasonable attorneys’ fees and costs) arising from or related to any breach of the foregoing representation and warranties.
**EQUAL OPPORTUNITY GUIDELINES:** The City requires all contractors doing business with the City not to discriminate against anyone on the basis of race, age, color, religion, gender, sexual orientation, ancestry, national origin, and non-job-related disabilities. This program was approved by the City Council on May 27, 1974. In accordance with this program the City shall require that the contractor be familiar and comply in every respect with the provisions of this program. Information regarding the program may be obtained by contacting the Human Relations Department 309/434-2218.

**INDEMNIFICATION:** Contractor shall indemnify, defend with counsel approved by City, and hold harmless City, its officers, officials, employees and volunteers from and against all liability, loss, damage, expense, cost (including without limitation reasonable attorney’s fees, expert fees and all other costs and fees of litigation) of every nature arising out of or in connection with Contractor’s performance of work hereunder or its failure to comply with any of its obligations contained in this Agreement, regardless of City’s passive negligence, but excepting such loss or damage which is caused by the sole active negligence or willful misconduct of the City. Should City in its sole discretion find Contractor’s legal counsel unacceptable, then Contractor shall reimburse the City its costs of defense, including without limitation reasonable attorney’s fees, expert fees and all other costs and fees of litigation. The Contractor shall promptly pay any final judgment rendered against the City (and its officers, officials, employees and volunteers) covered by this indemnity obligation. It is expressly understood and agreed that the foregoing provisions are intended to be as broad and inclusive as is permitted by the law of the State of Illinois and will survive termination of this Agreement.
CITY OF BLOOMINGTON, IL  
GENERAL INSURANCE REQUIREMENTS FOR VENDORS/CONTRACTORS/BIDS

Prior to the commencement of work governed by any contract between the CITY and the contractor, the contractor shall provide the CITY satisfactory evidence of insurance coverage. A Certificate of Insurance AND any contract stating the CITY, its employees and officials as additional named insured’s will be required and will also denote the description of the job. The contractor’s insurance shall be primary and non-contributory.

All insurance coverage should be placed with a solid carrier who has no less than an A- VIII Best’s Rating. The Contractor’s program shall hold the CITY, its employees and officials harmless from and against all loss, cost, expense, damage, liability or claims, whether groundless or not, arising out of the bodily injury, sickness or disease (including death resulting at any time therefrom).

All coverage, as follows shall be maintained through the life of the contract and include, as a minimum:

**General Liability** - $1,000,000 Bodily Injury and Property Damage (Combined Single Limit) with $2,000,000 GL annual aggregate and will include:
- Medical payments - $5,000
- Premises Operations
- Products and Completed Operations
- Blanket Contractual Liability
- Personal Injury Liability
- Expanded Definition of Property Damage

**Workers’ Compensation and Employer’s Liability** –
- $500,000 Bodily Injury by Accident
- $500,000 Bodily Injury by Disease, policy limits
- $500,000 Bodily Injury by Disease, each employee

**Automobile Liability** - $1,000,000 Bodily Injury and Property Damage (CSL)
(Owned, Non-owned and Hired vehicles should be included) and include $10,000 medical pay per passenger.

**Umbrella Liability Coverage** - $3,000,000 each occurrence, $3,000,000 aggregate
(These limits will be excess over all underlying coverage documents and would be the minimum required). Increased limits may be required on “larger contracts” and would be at the discretion, and approval of the, CITY’S legal counsel.

All Liability (General Liability/Auto) insurance certificates should include a “blanket additional insured” endorsement, must specify that should described policies be cancelled before the expiration date thereof, notice will be delivered in accordance with the policy provisions.
**GIFT BAN ACT:** I certify that __________________________________________ (print company name), its officers, employees and agents, have not made any gifts to officers or employees of the City of Bloomington in violation of Illinois Compiled Statutes, 5 ILCS 430/Article 10, State Officers and Employees Ethics Act (commonly known as the “Gift Ban Act”). The Act is available online at: http://www.ilga.gov/legislation/ilcs/ilcs4.asp?DocName=000504300HArt%2E+10&ActID=2529&ChapterID=2&SeqStart=1700000&SeqEnd=2200000 under.

I further certify that as a bidder, I have not violated the Bloomington City Code Chapter 2, Administration; Article I, Section 8: Officers and Employees Generally: Section 8a Prohibition on the Solicitation and Acceptance of Gifts; and 8b State Officials and Employees Ethics Act. This section of the Bloomington City Code is available online at http://www.cityblm.org/code.asp?show=section&id=3450.

_________________________________________  __________________________________________
Print Name & Date                                     Authorized Signature

**Vendor Compliance with Public Act 85-1295:** The vendor certifies by signing this statement that this bid is made without prior understanding, agreement or accord with any other person submitting a bid for the same product or service and that this bid is in all respects bona fide, fair and not the result of any act of fraud or collusion with another person engaged in the same line of business or commerce. Furthermore, the firm certifies that it is not barred from bidding on this contract as a result of a conviction for the violation of State laws prohibiting bid-rigging or bid-rotating. Any false statement hereunder constitutes a felony and can result in a fine and imprisonment as well as civil damages. The vendor also understands that failure to sign this statement will make the bid non-responsive and unqualified for award.

_________________________________________  __________________________________________
Print Name & Date                                     Authorized Signature

**Company Name**

**Insurance:** Vendors providing a service or installing equipment on or about City property shall provide to the City Clerk evidence of Comprehensive, Liability, and Workman's Compensation insurance prior to commencement of work on City property. The vendor guarantees to save the City, its agents or employees, harmless from liability of any nature or kind, for use of any copyright, composition, secret process, patented or unpatented invention, articles or appliances furnished or used in the performance of the contract, or which the vendor is not the patentee, assignee, or licensee.

Furthermore, the vendor hereby agrees to save and hold harmless and indemnify the City from and against all injury, death, damage, loss, claims and liability caused by or arising out of the performance of this agreement by the Vendor, its employees, agents or sub-vendors. This agreement extends to all claims, of any nature, whether made by the Vendor’s employees or third parties.

_________________________________________  __________________________________________
Print Name & Date                                     Authorized Signature

**Company Name**
The City of Bloomington has adopted a local preference purchasing policy. Under the terms of the policy local contractors may be granted a pre-determined preference in competitive bidding situations. Bids from qualified local bidders may receive the following adjustment to the submitted bid:

1. 5% up to a maximum of $2,500 on bids of $10,000 up to $50,000;
2. 4% up to a maximum of $10,000 on bids of up to $250,000;
3. 3% up to a maximum of $30,000 on bids of up to $1,000,000; and
4. $50,000 on bids of over $1,000,000.

For purposes of comparison and consideration in awarding contracts the preferential discount will be applied to the low bid of all qualified local bidders when determining the lowest responsible bid. The City Council reserves the right to waive or amend the local preference purchasing policy in connection with any bid, when it deems it in the best interest of the citizens of Bloomington.

A Local Bidder is defined as any business that meets all of the following criteria:

1. The business has established and maintained a physical presence within the County of McLean, via the ownership or lease of a building or a portion of a building for a period of not less than 12 consecutive months; and
2. The business employs a minimum of two full time employees at the McLean County location and those employees spend the majority of their work day and work week at the McLean County location; and
3. The business is legally authorized to conduct business within the State of Illinois and the County of McLean.

The undersigned hereby certifies to the City of Bloomington that it is a Local Bidder as defined above and qualifies for the Local Bidder Preference pursuant to the City of Bloomington Local Preference Purchasing Policy.

______________________________  __________________________________________
Print Name & Date  Authorized Signature

_______________________________________________________
Company Name
REFERENCES:
Three (3) references are required with your bid. The references shall be from three different sources where you have provided the minimum specifications as required in this bid. Bidder may use the City of Bloomington as one reference if the Bidder has provided this equipment or service to the City since January 1, 2010

1. Company Name: __________________________________________________________
   Company address: ___________________________________________________________
   City: __________________ State: _______ Zip: __________________
   Company Contact Name or Department: _________________________________________
   Company Contact Telephone: __________________ Fax: _______________________
   Company Contact e-mail address: _____________________________________________

2. Company Name: __________________________
   Company address: ___________________________________________________________
   City: __________________ State: _______ Zip: __________________
   Company Contact Name or Department: _________________________________________
   Company Contact Telephone: __________________ Fax: _______________________
   Company Contact e-mail address: _____________________________________________

3. Company Name: ________________________
   Company address: ___________________________________________________________
   City: __________________ State: _______ Zip: __________________
   Company Contact Name or Department: _________________________________________
   Company Contact Telephone: __________________ Fax: _______________________
   Company Contact e-mail address: _____________________________________________
EQUAL EMPLOYMENT OPPORTUNITY

In the event of the contractor's non-compliance with the provisions of this Equal Opportunity Clause, the Illinois Human Rights Act or the Rules and Regulations of the Illinois Department of Human Rights ("Department"), or the City of Bloomington's Contract Compliance Program, the contractor may be declared ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, including the City of Bloomington, and the contract may be canceled or voided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by statute, ordinance or regulation. During the performance of this contract, the contractor agrees as follows:

(1) That it will not discriminate against any employee or applicant for employment because of race, color, religion, gender, sexual orientation, marital status, national origin or ancestry, age, physical or mental disability unrelated to ability, or an unfavorable discharge from military service; and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such under-utilization.

(2) That, if it hires additional employees in order to perform this contractor any portion thereof, it will determine the availability (in accordance with the Department's Rules and Regulations or those of the Human Relations Commission) of minorities and women in the area(s) from which it may reasonably recruit and it will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.

(3) That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, gender, sexual orientation, marital status, national origin or ancestry, age, physical or mental disability unrelated to ability, familial status, or an unfavorable discharge from military service.

(4) That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the contractor's obligations under the Illinois Human Rights Act and the Department's Rules and Regulations. If any such labor organization or representative fails or refuses to cooperate with the contractor in its efforts to comply with such Act and Rules and Regulations, the contractor will promptly so notify the Department and Human Relations Commission and the contracting agency and will recruit employees from other sources when necessary to fulfill its obligations thereunder.

(5) That it will submit reports as required by the Department's Rules and Regulations and Human Relations Commission, furnish all relevant information as may from time to time be requested by the Department or the contracting agency, and in all respects comply with the Illinois Human Rights Act and the Department's Rules and Regulations and those of the City of Bloomington's Contract Compliance Program.

(6) That it will permit access to all relevant books, records, accounts and work sites by personnel of the contracting agency and the Department for purposes of investigation to ascertain compliance with the Illinois Human Rights Act and the Department's Rules and Regulations and those of the City of Bloomington's Contract Compliance Program.

(7) That it will include verbatim or by reference the provisions of this clause in every subcontract it awards under which any portion of the contract obligations are undertaken or assumed, so that such provisions will be binding upon such subcontractor. In the same manner as with other provisions of this contract, the contractor will be liable for compliance with applicable provisions of this clause by such subcontractors; and further it will promptly notify the contracting agency, the Department and the Human Relations Commission in the event any subcontractor fails or refuses to comply therewith. In addition, the contractor will not utilize any subcontractor declared by the Illinois Human Rights Commission or Human Relation Commission to be ineligible for contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations including the City of Bloomington.
To Whom It May Concern:

The City of Bloomington's Equal Opportunity in Purchasing Ordinance and the Bloomington Human Relations Ordinance requires that any company doing business with the City in the excess of $25,000 during one year, must submit an Equal Opportunity Report Form or an Equal Opportunity Plan.

It is my understanding that your company will be or are presently a contractor for the City of Bloomington. In order for this office to approve your company to continue to conduct business with the City of Bloomington, all of the enclosed forms must be submitted to the Community Relations Division within 14 days after receipt of the requested information. If you are bidding for the opportunity to work for the City of Bloomington, the Contract Compliance Report Form enclosed in the bid packet must be completed, signed and returned in the bid packet.

Please complete the enclosed information in its entirety and return it to the Community Relations Office or with your bid packet. If your company has an approved Equal Opportunity Plan, you may submit it instead of completing the enclosed Contract Compliance Form. You must also include a breakdown of your present workforce by race and gender.

If the information requested is not submitted, your company may not be approved to do business with the City of Bloomington and could subsequently not be placed on the "Approved Contractor List."

If you should have any questions regarding either of the forms, please feel free to contact me at (309) 434-22215.

Sincerely,

Equal Opportunity Associate
Section I. Identification

1. Company Name and Address:

Name: ______________________________________

D/b/a: ______________________________________

Address: _____________________________________

City/State/Zip: ________________________________

Telephone Number(s) Area Code: ________________

Check one of the following:

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<th>Partnership</th>
<th>Individual Proprietorship</th>
<th>Limited Liability Corp.</th>
</tr>
</thead>
</table>

2. Name and Address of the Company’s Principal Office (answer only if not the same as above).

Name: ______________________________________

Address: _____________________________________

City/State/Zip: ________________________________

3. Major activity of your company (product or service):
Description of EEO Policies and Practices

A. Is it the Company’s policy to recruit, hire, train, upgrade, and discipline persons without regard to race, sex, color, religion, national origin, age, mental and/or physical disability, and sexual orientation?

YES ____ NO ____

B. Has someone been assigned to develop procedures, which will assure that the EO policy is implemented and enforced by managerial, administrative, and supervisory personnel? If so, please indicate the name and title of the charged with this responsibility.

Name: ________________________________
Title: ________________________________
Telephone: ___________________________

C. Has the Company developed a written Equal Opportunity Plan? Note: A copy of the Equal Opportunity Plan must be submitted with this form in order to be considered eligible to do business with the /city of Bloomington. If you would need technical assistance in developing your plan, please contact the Community Relations Office at: (309) 434-2215.

YES ____ NO ____

D. Has the Company developed a written policy statement prohibiting Sexual Harassment? Please attach a copy of the policy statement.

YES ____ NO ____

E. Have all recruitment sources been notified that the Company will consider all qualified applicants without regard to race, color, age, sex, national origin, religion, mental and/or physical disability, or sexual orientation?

YES ____ NO ____

F. If advertising is used, does it specify that all qualified applicants will be considered for employment without regard to race, color, age, sex, national origin, religion, mental and/or physical disability, or sexual orientation?

YES ____ NO ____
G. Has the contractor notified all of its sub-contractors of their obligations to comply with the Equal Opportunity requirements either in writing, by inclusion in subcontractors or purchase orders?

YES ______ NO ______

H. Is the Company a state certified minority/female owned business? If yes, please attach a copy of the state certification.

YES ______ NO ______

I. Does the Company have collective bargaining agreements with labor organizations?

YES ______ NO ______

J. Has the labor organization been notified of the Company’s responsibility to comply with the Equal Employment Opportunity requirements in all contracts by the City of Bloomington?

YES ______ NO ______

Section III. Employment Information

A. Please complete the company workforce analysis form on the bottom of this page. Use the number of employees as of the most recent payroll period. Be sure to complete all applicable columns.

B. Job Classifications (See descriptions attached)

C. Identify the geographical area(s) from which the company may reasonably recruit employees (use city, county, SMSA, or distance in miles from your company location).

D. If minorities and women are currently under-utilized in your workforce, please attach a copy of an explanation for your plan to recruit and hire minorities and women.

Section IV. Certification

The Company certifies that it has answered all of the foregoing questions truthfully to the best of its knowledge and belief. The Company also agrees that it will comply and abide by the City of Bloomington’s Contract Compliance Ordinance and the City of Bloomington Human Relations Ordinance.

Signature: ___________________________ Print Name & Title: ___________________________
Telephone Number: __________________ Date: __________________
# CONTRACT COMPLIANCE WORKFORCE ANALYSIS

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M= Male, Column B is sum of rows D, F, H, J, and L

F= Female, Column C is sum of Rows E, G, I, K, and M

Date of above: ________________________

Name of person that compiled the above data: _____________________
ORDINANCE NO. 2017 - 51

AN ORDINANCE OF THE CITY OF BLOOMINGTON, McLEAN COUNTY, ILLINOIS AScertaining the PREVAILING RATES OF WAGES FOR LABORERS, WORKERS AND MECHANICS ENGAGED IN PUBLIC WORKS WITH THE CITY OF BLOOMINGTON

WHEREAS, the Prevailing Wage Laws, 820 ILCS 130/1 et seq., as amended, require that each public body awarding any construction contract for public work or doing such work by day labor shall ascertain the general prevailing hourly rates of wages for employees engaged on such work; and

WHEREAS, “public work”, as defined in the Prevailing Wage Law, includes commercial or industrial projects financed in whole or in part through the issuance of revenue bonds by the City of Bloomington under authority of the Industrial Project Bond Act or Home Rule Ordinance or financed in whole or in part through other public funds, without regard to what person or entity formally contracts for such work; and

WHEREAS, the statutes further provide that said rates be published, publicly posted and/or kept available for inspection by any interested party in the Office of the Secretary of State and Labor Department; and

WHEREAS, the City of Bloomington believes Prevailing Wage Law should apply to private commercial economic development projects directly supported by public funds, including projects supported by Tax Increment Financing or tax incentives of any kind; and

WHEREAS, the City of Bloomington believes that contractors awarded contracts for public work as defined by state statute and this Ordinance should, as a prerequisite to such contract, provide proof of participation in apprenticeship and training programs approved and registered with the United States Department of Labor’s Bureau of Apprenticeship and Training for all construction contracts in excess of $100,000.

NOW, THEREFORE, BE IT ORDAINED by the City Council of the City of Bloomington, County of McLean, State of Illinois that the prevailing wages as established and regularly updated by the Illinois Department of Labor are incorporated herein by reference as the prevailing rates of hourly wages in the City of Bloomington, Illinois for the laborers, workers and mechanics specified therein who are engaged in the construction of public works within the jurisdiction of this municipality; and

BE IT ORDAINED that the prevailing wages as established and regularly updated by the Illinois Department of Labor, last determined and as show on the attached McLean County Prevailing Wage Rates for June 2017, shall be paid to laborers, workers and mechanics specified therein when such persons perform work on private commercial economic development projects directly supported by public funds, including projects supported by Tax Increment Financing or tax incentives of any kind; and

BE IT ORDAINED that contractors shall submit to the City on a monthly basis all certified payroll records for prevailing wage work performed by contractor employees and subcontractors. The certified payroll records must include the following for each employee employed on the project: Name, Address, Telephone Number, Social Security Number, Job Classification, hourly wages paid in each pay period,
number of hours worked each day and starting and ending time of work each day. The contractor shall submit these records with a signed statement that the records are true and accurate, that the wages paid to each worker are not less than the prevailing rate and that the contractor is aware that filing records known to be false is a Class B misdemeanor offense; and

BE IT ORDAINED that contractors awarded contracts for public work as defined by state statute and this Ordinance should, as a prerequisite to such contract, provide proof of participation in apprenticeship and training programs approved and registered with the United States Department of Labor’s Bureau of Apprenticeship and Training for all construction contracts in excess of $100,000; and

BE IT ORDAINED that nothing herein contained shall be construed to apply said prevailing hourly rates of wages in the locality to any work or employment other than public works or private commercial economic development projects directly supported by public funds as defined in the Act and this Ordinance; and

BE IT ORDAINED that contractors awarded contracts for public work as defined by state statute and this Ordinance should, as a prerequisite to such contract, obtain the current prevailing wage rates from the Illinois Department of Labor and regularly check for updated prevailing wage rates during the entire duration of said contract for the locality; and

BE IT ORDAINED that the City Clerk shall mail a copy of this Ordinance to any employer, any association of employers, and to any person or association of employees who have filed or do file their names and addresses with the Clerk requesting copies of any determination under said law of the particular rates and of the particular classes of persons whose wages will be affected by such rates; and

BE IT ORDAINED that the City Clerk shall promptly file a certified copy of this Ordinance with the Department of Labor of the State of Illinois; and

BE IT ORDAINED that the City Clerk, as required by law, shall cause to be published in a newspaper of general circulation within the area of this municipality a notice of this Ordinance and that it is the effective prevailing wage determination of this public body.

ADOPTED this 26th day of June, 2017

APPROVED this 27th day of June, 2017

CITY OF BLOOMINGTON
Tari Renner, Mayor

APPROVED AS TO FORM
Jeffery R. Jurgens, Corporate Counsel

ATTEST
Cherry Lawson, City Clerk
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**Legend**

-M-F OT Unless otherwise noted, OT pay is required for any hour greater than 8 worked each day, Mon through Fri. The number listed is the multiple of the base wage.

OSA Overtime pay required for every hour worked on Saturdays

OSH Overtime pay required for every hour worked on Sundays and Holidays

H/W Health/Welfare benefit

**Explanations**

MCLEAN COUNTY FENCE

ERECTOR - See Ironworkers.

IRONWORKERS (EAST) - That part of the county East of a diagonal line from Heyworth to a point half way between Chenoa and Weston.

TEAMSTERS (NORTH) - North of a straight line starting on the west side where Route 24 crosses McLean County line in a southeasterly direction to the most south-southwestern corner of Livingston County.
The following list is considered as those days for which holiday rates of wages for work performed apply: New Years Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day and Veterans Day in some classifications/counts. Generally, any of these holidays which fall on a Sunday is celebrated on the following Monday. This then makes work performed on that Monday payable at the appropriate overtime rate for holiday pay. Common practice in a given local may alter certain days of celebration. If in doubt, please check with IDOL.

Oil and chip resealing (O&C) means the application of road oils and liquid asphalt to coat an existing road surface, followed by application of aggregate chips or gravel to coated surface, and subsequent rolling of material to seal the surface.

**EXPLANATION OF CLASSES**

**ASBESTOS - GENERAL** - removal of asbestos material/mold and hazardous materials from any place in a building, including mechanical systems where those mechanical systems are to be removed. This includes the removal of asbestos materials/mold and hazardous materials from ductwork or pipes in a building when the building is to be demolished at the time or at some close future date. **ASBESTOS - MECHANICAL** - removal of asbestos material from mechanical systems, such as pipes, ducts, and boilers, where the mechanical systems are to remain.

**CERAMIC TILE FINISHER, MARBLE FINISHER, TERRAZZO FINISHER**

Assisting, helping or supporting the tile, marble and terrazzo mechanic by performing their historic and traditional work assignments required to complete the proper installation of the work covered by said crafts. The term “Ceramic” is used for naming the classification only and is in no way a limitation of the product handled. Ceramic takes into consideration most hard tiles.

**ELECTRONIC SYSTEMS TECHNICIAN**

Installation, service and maintenance of low-voltage systems which utilizes the transmission and/or transference of voice, sound, vision, or digital for commercial, education, security and entertainment purposes for the following: TV monitoring and surveillance, background/foreground music, intercom and telephone interconnect, field programming, inventory control systems, microwave transmission, multi-media, multiplex, radio page, school, intercom and sound burglar alarms and low voltage master clock systems.

Excluded from this classification are energy management systems, life safety systems, supervisory controls and data acquisition systems not intrinsic with the above listed systems, fire alarm systems, nurse call systems and raceways exceeding fifteen feet in length.

**LABORER, SKILLED - BUILDING**

The skilled laborer building (BLD) classification shall encompass the following types of work, irrespective of the site of the work: tending of carpenters in unloading, handling, stockpiling and distribution operations, also other building crafts, mixing, handling, and conveying of all materials used by masons, plasterers and other building construction crafts, whether done by hand or by any process. The drying of plastering when done by salamander heat, and the cleaning and clearing of all debris. All work pertaining to and in preparation of asbestos abatement and removal. The building of scaffolding and staging for masons and plasterers. The excavations for buildings and all other construction, digging of trenches, piers, foundations and holes, digging, lagging, sheeting, cribbing, bracing and propping of foundations, holes, caissons, cofferdams, and dikes, the setting of all guidelines for machine or hand excavation and subgrading. The mixing, handling, conveying, pouring, vibrating, gunmilling and otherwise applying of concrete, whether by hand or other method of concrete for any walls, foundations, floors, or for other construction concrete sealant men. The wrecking, stripping, dismantling, and handling of concrete forms and false work, and the building of centers for fireproofing purposes. Boring machine, gas, electric or air in preparation for shoving pipe, telephone cable, and so forth, under highways, roads, streets and alleys. All hand and power operating cross cut saws when used for clearing. All work in compressed air construction. All work on acetylene burners in salvaging. The blocking and tamping of concrete. The laying of sewer tile and conduit, and pre-cast materials. The assembling and dismantling of all
jacks and sectional scaffolding, including elevator construction and running of slip form jacks. The work of drill running and blasting, including wagon drills. The wrecking, stripping, dismantling, cleaning, moving and oiling of forms. The cutting off of concrete piles. The loading, unloading, handling and carrying to place of installation of all rods, (and materials for use in reinforcing) concrete and the hoisting of same and all signaling where hoist is used in this type of construction coming under the jurisdiction of the Laborers' Union.

And, all other labor work not awarded to any other craft. Mortar mixers, kettlemen and carrier of hot stuff, tool crib men, watchmen (Laborer), firemen or salamander tenders, flagmen, deck hands, installation and maintenance of temporary gas-fired heating units, gravel box men, dumpmen and spotters, fensing Laborers, cleaning lumber, pit men, material checkers, dispatchers, unloading explosives, asphalt plant laborers, writer of scale tickets, fireproofing laborers, janitors, asbestos abatement and removal laborers, handling of materials treated with oil, creosote, chloride, asphalt, and/or foreign material harmful to skin or clothing. Laborers with de-watering systems, gunnite nozzle men, laborers tending masons with hot material or where foreign materials are used, Laborers handling masterplate or similar materials, laser beam operator, concrete burning machine operator, material selector men working with firebrick or combustible material, dynamite men, track laborers, cement handlers, chloride handlers, the unloading and laborers with steel workers and re-bars, concrete workers (wet), lutenman, asphalt raker, curb asphalt machine operator, ready mix scalemen, permanent, portable or temporary plant drilling machine operator, plaster tenders, underpinning and shoring of buildings, fire watch, signaling of all power equipment, to include trucks excavating equipment, etc., tree topper or trimmer when in connection to construction, tunnel helpers in free air, batch dumpers, kettle and tar men, tank cleaners, plastic installers, scaffold workers, motorized buggies or motorized unit used for wet concrete or handling of building materials, sewer workers, rod and chain men, vibrator operators, mortar mixer operator, cement silica, clay, fly ash, lime and plasters, handlers (bulk or bag), caisson workers, on concrete paving, placing, cutting and tying of reinforcing, deck hand, dredge hand and shore laborers, bankmen on floating plant, asphalt workers with machine & layers, grade checker, power tools, caisson workers, lead man on sewer work, welders, cutters, burners and torch men, chain saw operators, paving breaker, jackhammer and drill operator, layout man and/or drainage tile layer, steel form setters - street and highway, air tamping hammerman, signal man on crane, concrete saw operator, screen man on asphalt pavers, front end man on chip spreader, multiple concrete duct -- lead man.

LABORER, SKILLED - HIGHWAY

The skilled laborer heavy and highway (HWY) classification shall encompass the following types of work, irrespective of the site of the work: handling of materials treated with oil, creosote, asphalt and/or any foreign materials harmful to skin or clothing, track laborers, chloride handlers, the unloading and loading with steel workers and re-bars, concrete workers (wet), tunnel helpers in free air, batch dumpers, mason tenders, kettle and tar men, plastic installers, scaffold workers, motorized buggies or motorized unit used for wet concrete or handling of building materials, laborers with de-watering systems, sewer workers plus depth, rod and chainmen, vibrator operators, mortar mixer operators, cement silica, clay, fly ash, lime and plasters, handlers (bulk or bag), caisson workers plus depth, on concrete paving, placing, cutting and tying -- or reinforcing, deck hand, dredge hand shore laborers, bankmen on floating plant, asphalt workers with machine, and layers, grade checker, power tools, stripping of all concrete forms excluding paving forms, dumpmen and spotters, when necessary, caisson workers plus depth, gunnite nozzle men, welders, cutters, burners and torchmen, chain saw operators, paving breaker, jackhammer and drill operators, layout man and/or drainage tile layer, steel form setters - street and highway, air tamping hammerman, signal man on crane, concrete saw operator, screedman on asphalt pavers, front end man on chip spreader, multiple concrete duct, lutenman, asphalt raker, curb asphalt machine operator, ready mix scalemen (portable or temporary plant), laser beam operator, concrete burning machine operator, and coring machine operator.

TRUCK DRIVER - BUILDING, HEAVY AND HIGHWAY CONSTRUCTION - SOUTH

Class 1. Drivers on 2 axle trucks hauling less than 9 ton. Air compressor and welding machines and brooms, including those pulled by separate units, truck driver helpers, warehouse employees, mechanic helpers, greasers and firemen, pickup trucks when hauling materials, tools, or workers to and from and on-the-job site, and fork lifts up to 6,000 lb. capacity.

Class 2. Two or three axle trucks hauling more than 9 ton but hauling less than 16 ton. A-frame winch trucks, hydrolift trucks, vactor trucks or similar equipment when used for transportation purposes. Fork lifts over 6,000 lb. capacity, winch trucks, four axle combination units, and ticket writers.
Class 3. Two, three or four axle trucks hauling 16 ton or more. Drivers on water pulls, articulated dump trucks, mechanics and working forepersons, and dispatchers. Five axle or more combination units.

Class 4. Low Boy and Oil Distributors.

Class 5. Drivers who require special protective clothing while employed on hazardous waste work. TRUCK DRIVER - BUILDING, HEAVY AND HIGHWAY

CONSTRUCTION - NORTH

Class 1. Two or three Axle Trucks. A-frame Truck when used for transportation purposes; Air Compressors and Welding Machines, including those pulled by cars, pick-up trucks and tractors; Ambulances; Batch Gate Lockers; Batch Hopperman; Car and Truck Washers; Carry-alls; Fork Lifts and Hoisters; Helpers; Mechanics Helpers and Greasers; Oil Distributors 2-man operation; Pavement Breakers; Pole Trailer, up to 40 feet; Power Mower Tractors; Self-propelled Chip Spreader; Skipman; Slurry Trucks, 2-man operation; Slurry Truck Conveyor Operation, 2 or 3 men; Teamsters; Unskilled dumpman; and Truck Drivers hauling warning lights, barricades, and portable toilets on the job site.

Class 2. Four axle trucks; Dump Crets and Adgetors under 7 yards; Dumpster, Track Trucks, Euclids, Hug Bottom Dump Turnpulls or Turntrailers when pulling other than self-loading equipment or similar equipment under 16 cubic yards; Mixer Trucks under 7 yards; Ready-mix Plant Hopper Operator, and Winch Trucks, 2 Axles.

Class 3. Five axle trucks; Dump Crets and Adgetors 7 yards and over; Dumpster, Track Trucks, Euclids, Hug Bottom Dump Turntrailers or turnpulls when pulling other than self-loading equipment or similar equipment over 16 cubic yards; Explosives and/or Fission Material Trucks; Mixer Trucks 7 yards and over; Mobile Cranes while in transit; Oil Distributors, 1-man operation; Pole Trailer, over 40 feet; Pole and Expandable Trailers hauling material over 50 feet long; Slurry trucks, 1-man operation; Winch trucks, 3 axles or more; Mechanic-Truck Welder and Truck Painter.

Class 4. Six axle trucks; Dual-purpose vehicles, such as mounted crane trucks with hoist and accessories; Foreman; Master Mechanic; Self-loading equipment like P.B. and trucks with scoops on the front. TRUCK DRIVER - OIL AND CHIP RESEALING ONLY.

This shall encompass laborers, workers and mechanics who drive contractor or subcontractor owned, leased, or hired pickup, dump, service, or oil distributor trucks. The work includes transporting materials and equipment (including but not limited to, oils, aggregate supplies, parts, machinery and tools) to or from the job site; distributing oil or liquid asphalt and aggregate; stock piling material when in connection with the actual oil and chip contract. The Truck Driver (Oil & Chip Resealing) wage classification does not include supplier delivered materials.

OPERATING ENGINEERS - BUILDING

Class 1. Cranes; Overhead Cranes; Gradall; All Cherry Pickers; Mechanics; Central Concrete Mixing Plant Operator; Road Pavers (27E - Dual Drum - Tri Batchers); Blacktop Plant Operators and Plant Engineers; 3 Drum Hoist; Derricks; Hydro Cranes; Shovels; Skinner Scoops; Koehring Scooper; Drag Lines; Backhoe; Derrick Boats; Pile Drivers and Skid Rig; Clamshells; Locomotive Cranes; Dredge (all types) Motor Patrol; Power Blades - Dumore - Elevating and similar types; Tower Cranes (Crawler-Mobile) and Stationary; Crane-type Backfiller; Drott Yumbo and similar types considered as Cranes; Caisson Rigs; Dozer; Tournadozer; Work Boats; Ross Carrier; Helicopter; Tournapulls - all and similar types; Scoops (all sizes); Pushcats; Endloaders (all types); Asphalt Surfacing Machine; Slip Form Paver; Rock Crusher; Heavy Equipment Greaser; CMI, CMI Belt Placer, Auto Grade & 3 Track and similar types; Side Booms; Multiple Unit Earth Movers; Creter Crane; Trench Machine; Pump-crete-Belt Crete- Squeeze Cretes-Screw-type Pumps and Gypsum; Bulker & Pump - Operator will clean; Formless Finishing Machine; Flaherty Spreader or similar types; Screed Man on Laydown Machine; Wheel Tractors (industrial or Farm-type w/Dozer-Hoe-Endloader or other attachments); F.W.D. & Similar Types; Vermeer Concrete Saw.

Class 2. Dinkeys; Power Launches; PH One-pass Soil Cement Machine (and similar types); Pugmill with Pump; Backfillers; Euclid Loader; Forklifts; Jeeps w/Ditching Machine or other attachments; Tuneluger; Automatic Cement and Gravel
Batching Plants; Mobile Drills (Soil Testing) and similar types; Gurries and Similar Types; (1) and (2) Drum Hoists (Buck Hoist and Similar Types); Chicago Boom; Boring Machine & Pipe Jacking Machine; Hydro Boom; Dewatering System; Straw Blower; Hydro Seeder; Assistant Heavy Equipment Greaser on Spread; Tractors (Track type) without Power Unit pulling Rollers; Rollers on Asphalt -- Brick Macadam; Concrete Breakers; Concrete Spreaders; Mule Pulling Rollers; Center Stripper; Cement Finishing Machines & CMIM Texture & Reel Curing Machines; Cement Finishing Machine; Barber Green or similar loaders; Vibro Tamper (All similar types) Self-propelled; Winch or Boom Truck; Mechanical Bull Floats; Mixers over 3 Bag to 27E; Tractor pulling Power Blade or Elevating Grader; Porter Rex Rail; Clary Screed; Truck Type Hoptoe Oilers; Fireman; Spray Machine on Paving; Curb Machines; Truck Crane Oilers; Oil Distributor; Truck-Mounted Saws.

Class 3. Air Compressor; Power Subgrader; Straight Tractor; Trac Air without attachments; Herman Nelson Heater, Dravo, Warner, Silent Glo, and similar types; Roller: Five (5) Ton and under on Earth or Gravel; Form Grader; Crawler Crane & Skid Rig Oilers; Freight Elevators - permanently installed; Pump; Light Plant; Generator; Convoyor (1) or (2) - Operator will clean; Welding Machine; Mixer (3) Bag and Under (Standard Capacity with skip); Bulk Cement Plant; Oiler on Central Concrete Mixing Plant.

OPERATING ENGINEERS - HEAVY AND HIGHWAY CONSTRUCTION

CLASS 1. Cranes; Hydro Cranes; Shovels; Crane Type Backfiller; Tower, Mobile, Crawler, & Stationary Cranes; Derrick; Hoists (3 Drum); Draglines; Drott Yumbo & Similar Types considered as Cranes; 360 Degree Swing Excavator (Shears, Grapples, Movacs, etc.); Back Hoe; Derrick Boats; File Driver and Skid Rigs; Clam Shell; Locomotive - Cranes; Road Pavers - Single Drum - Dual Drum - Tri Batcher; Motor Patrols & Power Blades - Dumore - Elevating & Similar Types; Mechanics; Central Concrete Mixing Plant Operator; Asphalt Batch Plant Operators and Plant Engineers; Gradall; Caisson Rigs; Skimmer Scoop - Koering Scooper; Dredges (all types); Hoptoe; All Cherry Pickers; Work Boat: Ross Carrier; Helicopter; Dozer; Tournadozer; Tournapulls - all and similar types; Operation of Concrete and all Recycle Machines; Multiple Unit Earth Movers; Scoops (all sizes); Pushcats; Endloaders (all types); Asphalt Surfacing Machine; Slip Form Paver; Rock Crusher; Operation of Material Crusher, Screening Plants, and Tunnel Boring Machine; Heavy Equipment Greaser (top greaser on spread); CMI, Auto Grade, CMI Belt Placer & 3 Track and Similar Types; Side Booms; Asphalt Heater & Planer Combination (used to plane streets); Wheel Tractors (with Dozer, Hoe or Endloader Attachments); CAT Earthwork Compactors and Similar Types; Blaw Knox Spreader and Similar Types; Trench Machines; Pump Crete - Belt Crete - Squeeze Crete - Screw Type Pumps and Gypsum (operator will clean); Creter Crane; Operation of Concrete Pump Truck; Formless Finishing Machines; Flatery Spreader or Similar Types; Screed Man on Laydown Machine; Vermeer Concrete Saw; Operation of Laser Screed; Span Saw; Dredge Leverman; Dredge Engineer; Pull or Similar Type; Hydro-Boom Truck; Operation of Guard Rail Machine; and Starting Engineer on Pipeline or Construction (11 or more pieces) including: Air Compressor (Trailer Mounted), All Forced Air Heaters (regardless of Size), Water Pumps (Greater than 4-1/2” or Total Discharge Over 4-1/2”), Light Plants, Generators (Trailer Mounted - Excluding Decontamination Trailer), Welding Machines (Any Size or Mode of Power), Conveyor, Mixer (any size), Stud Welder, Power Pac, etc, and Ground Heater (Trailer Mounted).

CLASS 2. Bulker & Pump; Power Launches; Power Launces; Boring Machine & Pipe Jacking Machine; Dinkeys; Operation of Carts, Powered Haul Unit for a Boring Machine; P & H One Pass Soil Cement Machines and Similar Types; Wheel Tractors (Industry or Farm Type - Other); Back Fillers; Euclid Loader; Fork Lifts; Jeep w/Ditching Machine or Other Attachments; Tunnelugger; Automatic Cement & Gravel Batching Plants; Mobile Drills - Soil Testing and Similar Types; Pugmill with Pump; All (1) and (2) Drum Hoists; Dewatering System; Straw Blower; Hydro-Seeder; Bump Grinders (self- propelled); Assistant Heavy Equipment Greaser; Apsco Spreader; Tractors (Track-Type) without Power Units Pulling Rollers; Rollers on Asphalt - Brick or Macadam; Concrete Breakers; Concrete Spreaders; Cement Strippers; Cement Finishing Machines & CMI Texture & Reel Curing Machines; Vibro-Tamper (All Similar Types Self-Propelled); Mechanical Bull Floats; Self-Propelled Concrete Saws; Truck Mounted Power Saws; Operation of Curb Cutters; Mixers - Over Three (3) Bags; Winch and Boom Trucks; Tractor Pulling Power Blade or Elevating Grader; Porter Rex Rail; Clary Screed; Mule Pulling Rollers; Pugmill without Pump; Barber Greene or Similar Loaders; Track Type Tractor w/Power Unit attached (minimum); Fireman; Spray Machine on Paving; Curb Machines; Paved Ditch Machine; Power Broom; Self-Propelled Sweepers; Self-Propelled Conveyors; Power Subgrader; Oil Distributor; Straight Tractor; Truck Crane Oilers; Truck Type Oilers; Directional Boring Machine; Horizontal Directional Drill; Articulating End Dump Vehicles; Starting Engineer on Pipeline or Construction (6 -10 pieces) including: Air Compressor (Trailer Mounted), All Forced Air Heaters (regardless of Size), Water Pumps (Greater than 4-1/2” or Total
Discharge Over 4-1/2"), Light Plants, Generators (Trailer Mounted - Excluding Decontamination Trailer), Welding Machines (Any Size or Mode of Power), Conveyor, Mixer (any size), Stud Welder, Power Pac, etc., and Ground Heater (Trailer Mounted).

CLASS 3. Straight Framed Truck Mounted Vac Unit (separately powered); Trac Air Machine (without attachments); Rollers - Five Ton and Under on Earth and Gravel; Form Graders; Bulk Cement Plant; Oilers; and Starting Engineer on Pipeline or Construction (3 - 5 pieces) including: Air Compressor (Trailer Mounted), All Forced Air Heaters (regardless of Size), Water Pumps (Greater than 4-1/2" or Total Discharge Over 4-1/2"), Light Plants, Generators (Trailer Mounted - Excluding Decontamination Trailer), Welding Machines (Any Size or Mode of Power), Conveyor, Mixer (any size), Stud Welder, Power Pac, etc., and Ground Heater (Trailer Mounted).

Other Classifications of Work:

For definitions of classifications not otherwise set out, the Department generally has on file such definitions which are available. If a task to be performed is not subject to one of the classifications of pay set out, the Department will upon being contacted state which neighboring county has such a classification and provide such rate, such rate being deemed to exist by reference in this document. If no neighboring county rate applies to the task, the Department shall undertake a special determination, such special determination being then deemed to have existed under this determination. If a project requires these, or any classification not listed, please contact IDOL at 217-782-1710 for wage rates or clarifications.

LANDSCAPING

Landscaping work falls under the existing classifications for laborer, operating engineer and truck driver. The work performed by landscape plantsman and landscape laborer is covered by the existing classification of laborer. The work performed by landscape operators (regardless of equipment used or its size) is covered by the classifications of operating engineer. The work performed by landscape truck drivers (regardless of size of truck driven) is covered by the classifications of truck driver.
BID FORM
BID #2018-37
COLISEUM ELEVATOR ADDITION

We, the undersigned, agree to the terms and conditions used by the City of Bloomington, Illinois, at the bid price submitted, and to supply all services and/or commodities as required in the requirements and Instructions to Bidders. We further agree to deliver the commodity and/or services as outlined with in this document, FOB Bloomington, Illinois, freight prepaid. We further agree to complete all of the above work in a complete, neat, and workmanlike manner.

The bidder certifies by signature below that it has not been barred from contracting with a unit of State or Local government in the State of Illinois as a result of a violation of Section 33E-3 or 33E-4 of the Criminal Code of 1961, as amended. Payment of prevailing wage rates as predetermined by the Bloomington City Council pursuant to the Prevailing Wage Ordinance 2017-51 is acknowledged.

<table>
<thead>
<tr>
<th>ELEVATOR ADDITION; INCLUDING SITEWORK, UTILITIES, HEATING, ELECTRICAL, PLUMBING, MECHANICAL AND ALL OTHER NECESSARY WORK FOR A COMPLETE INSTALLATION (LUMP SUM)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTINGENCY (10%) OF ABOVE</td>
<td></td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td></td>
</tr>
</tbody>
</table>

The undersigned understands that any condition above, clarification made to the above, or information submitted on or with this form other than requested may render this bid unresponsive.

_________________________________________  _______________________________________
Firm                                                                 Authorized Signature

_________________________________________  _______________________________________
Address                                                                 City        State        Zip

_________________________________________  _______________________________________
Phone Number                                                                 Date

Email Address: __________________________________________
BID CHECKLIST:

1. Return the *entire* packet – not just your response
2. Sign and Attach all addenda if any were issued
3. Sign and date all required forms
4. Include a copy of your certificate of insurance for your business and any other required certificates, permits, etc.
5. Seal the envelope and attach the label or print in the lower left corner of the outer envelope the bid/proposal name and date due
6. Your (1) original and (2) required copies
7. Bid Bond
8. Anything relative to this bid

TENTATIVE BID SCHEDULE:

A. The following projected timetable should be used as a working guide for planning purposes. The City reserves the right to adjust this timetable as required during the course of the bid process.

<table>
<thead>
<tr>
<th>Action</th>
<th>Due Date</th>
<th>Due Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>BID Released</td>
<td>Wednesday, February 28, 2018</td>
<td>N/A</td>
</tr>
<tr>
<td>Pre-Bid / Site Visit</td>
<td>Wednesday, March 7, 2018</td>
<td>10:00 a.m. Central Time</td>
</tr>
<tr>
<td>Questions Due to City</td>
<td>Tuesday, March 13, 2018</td>
<td>3:00 p.m. Central Time</td>
</tr>
<tr>
<td>Response from City</td>
<td>Friday, March 16, 2018</td>
<td>4:00 p.m. Central Time</td>
</tr>
<tr>
<td>BIDS Due</td>
<td>Thursday, March 22, 2018</td>
<td>10:00 a.m. Central Time</td>
</tr>
<tr>
<td>Anticipated Award Date</td>
<td>Monday, April 9, 2018</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Questions will be answered in the form of written addenda and provided to all Bidders, as per State of Illinois statutes. Submit questions regarding the bid in writing to Russel Waller, Facility Manager, at rwaller@cityblm.org and Misty Shafer, Procurement Specialist, at mshafer@cityblm.org no later than 3:00 p.m. Central Time on Tuesday, March 13, 2018.
CITY OF BLOOMINGTON
CONTRACT WITH

FOR
Coliseum Elevator Addition

THIS AGREEMENT, dated this ___ day of ____________, 2018, is between the City of Bloomington (hereinafter “CITY”) and (hereinafter “CONTRACTOR”).

NOW THEREFORE, the parties agree as follows:

Section 1. Recitals. The recitals set forth above are incorporated into this Section 1 as if specifically stated herein.

Section 2. Incorporation of Bid/RFP/RFQ & Proposal Terms / Prevailing Wage. This work was subject to the following procurement initiative by the CITY:
Bid #2018-37 Coliseum Elevator Addition (hereinafter “Request”) Accordingly, the provisions of the Request and the proposal submitted by CONTRACTOR (hereinafter collectively referred to as “Procurement Documents” and attached as Exhibit A), shall be incorporated into this Contract and made a part thereof and shall be considered additional contractual requirements that must be met by CONTRACTOR. In the event of a direct conflict between the provisions of this contract and the incorporated documents, the provisions of this contract shall apply. This contract calls for the construction of a “public work,” within the meaning of the Illinois Prevailing Wage Act, 820 ILCS 130/01 et seq. (“the Act”). The Act requires contractors and subcontractors to pay laborers, workers and mechanics performing services on public works projects no less than the current “prevailing rate of wages” (hourly cash wages plus amount for fringe benefits) in the county where the work is performed. The Department publishes the prevailing wage rates on its website. The Department revises the prevailing wage rates and the contractor/subcontractor has an obligation to check the Department’s web site for revisions to prevailing wage rates. For information regarding current prevailing wage rates, please refer to the Illinois Department of Labor’s website. All contractors and subcontractors rendering services under this contract must comply with all requirements of the Act, including but not limited to, all wage requirements and notice and record keeping duties.

Section 3. Description of Services. CONTRACTOR shall provide the services/work identified in the Procurement Documents, and specifically as follows: ____________________________

Section 4. Payment. For the work performed by CONTRACTOR under this Contract, the CITY shall pay CONTRACTOR one of the following:

☐ A flat fee of $_________ as set forth in the Procurement Documents.

☐ Fees as set forth in the Procurement Documents.

Section 5. Default and Termination. Either party shall be in default if it fails to perform all or any part of this Contract. If either party is in default, the other party may terminate this Contract upon giving written notice of such termination to the party in default. Such notice shall be in writing and provided thirty (30) days prior to termination. The non-defaulting party shall be entitled to all remedies, whether in law or equity, upon the default or a violation of this Contract. In addition, the prevailing party shall be entitled to reimbursement of attorney’s fees and court costs.
Section 6. **Representations of Vendor.** CONTRACTOR hereby represents it is legally able to perform the work that is subject to this Contract.

Section 7. **Assignment.** Neither party may assign this Contract, or the proceeds thereof, without written consent of the other party.

Section 8. **Compliance with Laws.** CONTRACTOR agrees that any and all work by CONTRACTOR shall at all times comply with all laws, ordinances, statutes and governmental rules, regulations and codes.

Section 9. **Compliance with FOIA Requirements.** CONTRACTOR further explicitly agrees to furnish all records related to this Contract and any documentation related to CITY required under an Illinois Freedom of Information Act (ILCS 140/1 et. seq.) ("FOIA") request within five (5) business days after CITY issues notice of such request to CONTRACTOR. CONTRACTOR agrees to not apply any costs or charge any fees to the CITY regarding the procurement of records required pursuant to a FOIA request. CONTRACTOR shall be responsible for any damages/penalties assessed to CITY for CONTRACTOR'S failure to furnish all documentation in CONTRACTOR'S possession responsive and related to a request within five (5) days after CITY issues a notice of a request.

Section 10. **Governing Law.** This Agreement shall be governed by and interpreted pursuant to the laws of the State of Illinois.

Section 11. **Joint Drafting.** The parties expressly agree that this agreement was jointly drafted, and that both had opportunity to negotiate its terms and to obtain the assistance of counsel in reviewing it terms prior to execution. Therefore, this agreement shall be construed neither against nor in favor of either party, but shall construed in a neutral manner.

Section 12. **Attorney Fees.** In the event that any action is filed in relation to this agreement, the unsuccessful party in the action shall pay to the successful party, in addition to all the sums that either party may be called on to pay, a reasonable sum for the successful party's attorneys' fees.

Section 13. **Paragraph Headings.** The titles to the paragraphs of this agreement are solely for the convenience of the parties and shall not be used to explain, modify, simplify, or aid in the interpretation of the provisions of this agreement.

Section 14. **Counterparts.** This agreement may be executed in any number of counterparts, each of which shall be deemed to be an original, but all of which together shall constitute the same instrument.

CITY OF BLOOMINGTON

By: ____________________________  By: ____________________________  
Its City Manager  Its ____________

ATTEST:

By: ____________________________  By: ____________________________  
City Clerk  Its ____________
SECTION 000105
CERTIFICATIONS

END OF SECTION
DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS
000101  Project Title Page
000105  Certifications
000110  Table of Contents
003100  Available Project Information

DIVISION 01 – GENERAL REQUIREMENTS
011000  Summary
011321  Electronic Files and CAD Release Form
012000  Price and Payment Procedures
013000  Administrative Requirements
014000  Quality Requirements
014100  Special Inspections and Tests
015000  Temporary Facilities and Controls
015001  Temporary Facilities and Controls
016000  Product Requirements
016001  Product Substitution Request Form
017000  Execution and Closeout Requirements
017419  Construction Waste Management

DIVISION 02 – EXISTING CONDITIONS
024119  Selective Demolitions

DIVISION 03 – CONCRETE
033000  Cast-in place Concrete
034500  Architectural Precast Concrete

DIVISION 04 – MASONRY
042200  Concrete Unit Masonry

DIVISION 05 – METALS
051200  Structural Steel
053123  Steel Roof Decking
055000  Metal Fabrications

DIVISION 06 – WOOD, PLASTICS AND COMPOSITES
061053  Miscellaneous Rough Carpentry

DIVISION 07 – THERMAL AND MOISTURE PROTECTION
072100  Thermal Insulation
075323  EPDM Roofing
076200  Sheet Metal Flashing and Trim
078100  Spray-applied Fire-resistive Materials
078413  Penetration Firestopping
079200  Joint Sealants

DIVISION 08 – OPENINGS
081113  Hollow Metal Doors and Frames
087100  Door Hardware
**DIVISION 09 – FINISHES**
- 096500 Resilient Flooring
- 096723 Resinous Flooring
- 096800 Carpeting
- 099113 Exterior Painting
- 099123 Interior Painting

**DIVISION 10 – SPECIALTIES**
- 101400 Signage

**DIVISION 14 – CONVEYING EQUIPMENT**
- 142400 Hydraulic Elevators

**DIVISION 21 - FIRE SUPPRESSION**
- See Drawings

**DIVISION 22 - PLUMBING**
- 220500 Common Work Results for Plumbing
- 220513 Common Motor Requirements for Plumbing Equipment
- 220523 General Duty Valves for Plumbing Piping
- 220529 Hangers and Supports for Plumbing Piping and Equipment
- 220548 Vibration Control for Plumbing
- 220553 Identification for Plumbing Piping and Equipment
- 220700 Plumbing Insulation
- 221316 Sanitary Waste and Vent Piping
- 221319 Sanitary Waste Piping Specialties
- 221416 Storm Drainage Piping
- 221423 Storm Drainage Piping Specialties
- 221429 Sump Pumps

**DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING**
- 230500 Common Work Results for HVAC
- 230513 Common Motor Requirements for HVAC Equipment
- 230529 Hangers and Supports for HVAC Piping and Equipment
- 230548 Vibration and Seismic Controls for HVAC Piping and Equipment
- 230553 Identification for HVAC Piping and Equipment
- 230593 Testing, Adjusting and Balancing
- 230700 HVAC Insulation
- 230900 HVAC Instrumentation and Control
- 230993 Sequence of Operation for HVAC Controls
- 232113 Hydronic Piping
- 233113 Metal Ducts
- 233300 Duct Accessories
- 233423 HVAC Power Ventilators
- 233600 Air Terminal Units
- 233713 Diffusers, Registers and Grilles
- 233723 HVAC Gravity Ventilators
- 238239 Unit Heaters
- 238316 Radiant Heating Hydronic Piping

**DIVISION 26 - ELECTRICAL**
- 260500 Common Work Results for Electrical
- 260519 Low-voltage Electrical Power Conductors and Cables
- 260526 Grounding and Bonding for Electrical Systems
- 260529 Hangers and Supports for Electrical Systems
260533  Raceway and Boxes for Electrical Systems
260553  Identification for Electrical Systems
260923  Lighting Controls
262416  Panelboards
262726  Wiring Devices
262813  Fuses
262816  Enclosed Switches and Circuit Breakers
262913  Enclosed Controllers
265100  Interior Lighting

DIVISION 31 - EARTHWORK
311000  Site Clearing
312000  Earth Moving

DIVISION 32 - EXTERIOR IMPROVEMENTS
321210  Aggregate Base Course
321313  Portland Cement Concrete Paving

DIVISION 33 - UTILITIES
334100  Storm Sewerage

End of Table of Contents

END OF SECTION
PART 1 - GENERAL

1.1 AVAILABLE PROJECT INFORMATION, GENERAL
   A. Coordinate with Architect to obtain Available Project Information for bidding.

1.2 GEOTECHNICAL REPORT
   A. A report prepared for BKV Group by Ramsey Geotechnical Engineering LLC, dated November 20, 2017, is included as available Project information following this Section.
   B. Borings: Soil Borings have been made at the site to assist in the design process. Soil Data and/or Logs are included in the Documents for the information and convenience of Bidders.
   C. Data Use Limitations: Because the sub-surface conditions indicated by the borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, and the firm reporting the sub-surface conditions based on the borings, do not warrant the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site.
   D. Bidder Responsibility: Persons using information described herein shall accept full responsibility for its use in preparing Bids and obtaining additional geotechnical information, which may be required.
   E. Extra Payment: No consideration for extra payment will be given for conditions occurring which could have been anticipated from the geotechnical information. If conditions occur resulting in extra work, which could not have been anticipated or reasonably inferred from the geotechnical information, the Conditions of the Contract shall apply.

1.3 EXISTING BUILDING DRAWINGS
   A. Existing building Drawings are available from Architect to be used for reference only. Contractor to field verify all existing building conditions.

1.4 PRELIMINARY PROJECT SCHEDULE
   A. The following project schedule is provided for general information only:
      2. Construction: April 9, 2018 to October 9, 2018.
      3. Completion Dates:
         b. Final Completion: November 9, 2018.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
Report of Soils Exploration

Grossinger Motors Arena Elevator Addition
Bloomington, Illinois

BKV Group
REPORT OF SOILS EXPLORATION
GROSSINGER MOTORS ARENA ELEVATOR ADDITION
BLOOMINGTON, ILLINOIS

PREPARED FOR
BKV GROUP
343 SOUTH DEARBORN STREET
CHICAGO, ILLINOIS 60604

PREPARED BY
RAMSEY GEOTECHNICAL ENGINEERING LLC
1701 WEST MARKET STREET
BLOOMINGTON, ILLINOIS 61701
(309) 821-0430
INTRODUCTION

This report presents results of our site exploration which was performed to determine subsurface soil and groundwater conditions for the proposed addition to Grossinger Motors Arena in Bloomington, Illinois. The geotechnical services were performed at the request of Mr. Craig Carter of BKV Group in accordance with the scope of services outlined in the Ramsey Geotechnical Engineering LLC (RGE) proposal dated February 7, 2017. Results of field and laboratory work and recommendations based upon that work are included in the following sections of this report.

SITE/PROJECT DESCRIPTION

Grossinger Motors Arena is located at 101 South Madison Street in Bloomington, Illinois. The new elevator is planned on the south side of the building. The addition will be a three story, steel framed structure with a brick and glass or precast concrete and glass exterior. A new single story, slab on grade storage structure is also planned adjacent to the elevator addition. The existing structure is supported on an augercast pile foundation system.

The area of the addition is currently covered with concrete sidewalks adjacent to the ADA entrance. A below grade, cast in place concrete electrical duct bank crosses the location of the addition below and parallel to the planned south wall.
FIELD EXPLORATION

Two (2) soil test borings were completed within the limits of the planned addition. The boring drilled within the limits of the three-story portion of the addition was extended to a depth of 40 feet. The boring located within the limits of the single-story portion of the addition was extended to a depth of 25 feet.

Prior to completing the borings, portions of the concrete sidewalks were removed by others in order to expose the electrical duct bank. Hydrovac excavations were then completed to the approximate bottom of the duct bank prior to completing the soil borings.

The borings were drilled and sampled according to currently recommended American Society for Testing and Materials (ASTM) specifications. Soil sampling was performed at 2-1/2 foot intervals to a depth of 15 feet and at 5 foot intervals thereafter to the bottom of the borings. The samples were obtained in conjunction with the Standard Penetration Test (N), for which the driving resistance of a 2 inch diameter split-spoon sampler provides an indication of the relative density of granular materials and consistency of cohesive soils. Water level readings were taken during and following completion of the drilling operations.

LABORATORY TESTING

Soil samples were examined in the laboratory to verify field descriptions and to determine classifications in accordance with the Unified Classification System. Laboratory testing included moisture content determinations on all cohesive soil types. Measurements of unconfined compressive strengths on natural cohesive soil samples were made. A calibrated penetrometer was also utilized to provide estimates of the unconfined compressive strength.

All phases of the laboratory testing program were conducted in general accordance with applicable ASTM standards. The results of these tests are shown on the boring logs included in the Appendix of this report.
SUBSURFACE CONDITIONS

Sand backfill which had been placed adjacent to the electrical duct bank was noted to a depth of approximately 8 feet at both boring locations. The sand had been disturbed during sidewalk removal and completion of the hydrovac excavations. This disturbance resulted in a relatively loose condition with N values generally at or below 6 blows per foot.

The soils below the sand backfill and extending to the termination depths of the borings consist of silty clay. These cohesive soils range from tough to very tough in relative consistency. Unconfined compressive strength values are generally between 1.5 and 3.5 tons per square foot (tsf). Corresponding moisture content values are typically below 15 percent.

Free water was noted in the sand backfill at depths of 6 to 7 feet while drilling at both boring locations.

ANALYSIS AND RECOMMENDATIONS

We recommend that the structure be supported at or below a depth of 8 feet on the tough to very tough silty clay. Spread footings bearing on these soils may be designed using a net allowable bearing pressure of 3,000 pounds per square foot (psf).

A deep foundation system consisting of drilled piers/caissons, augercast piling or helical piers could also be considered for support of the structure. Design recommendations for these foundation types follow.

For the purpose of determining capacities, we recommend a design value of 750 psf for adhesion between the drilled shafts or piles and the surrounding soils between depths of 8 and 18 feet. For portions of the piles extending below 18 feet, an adhesion value of 1,000 psf is recommended. A new allowable end bearing value of 5,000 psf is recommended for design of deep foundations bearing at or below a depth of 18 feet.
It must be noted that while pile capacities can be estimated based upon the results of soil tests, actual capacities should be confirmed by performing a field load test in accordance with ASTM D1143. Minimum spacing between the edges of adjacent piles of 3 times the diameter is recommended.

The integrity of an auger cast pile foundation is highly dependent upon the installation procedures. Care must be taken to control the rate of drilling and auger removal along with grout pressures and quantities. We recommend that site observations and tests include documentation of pile depths and diameters along with grout pressures and volumes.

In view of the relatively loose sand backfill, it is expected that temporary steel casing be will be required a depth of at least 8 feet to support the walls of the drilled pier shafts. This will minimize the inflow of water during drilling and cleaning operations. Pumps will likely also be required to remove water that does seep into the shaft to allow placement of concrete under dry conditions.

Care should be exercised in the installation of the casing to make sure that it is sealed into a clay layer that will maintain a water-tight seal when the soil is removed from inside the casing. It is anticipated that the casing will be required to the bottoms of the drilled piers. The last few feet of drilling and the removal of a portion of the soil from inside the casing should be delayed until concrete is on the job. When the drilling operations and inspections are complete, concrete should be placed inside the casing immediately. During simultaneous concrete placing and casing removal operations, sufficient concrete should be maintained inside the casing to offset the hydrostatic head of the groundwater outside the casing and prevent the intrusion of soil and groundwater in the pier concrete.
Drilled pier shafts must be clean and free of all loose material prior to the placement of concrete. A qualified representative of the soils engineer should verify that the drilled piers are bearing on competent bearing materials and that the caisson installation procedures meet specifications.

Site Subgrade Preparation

The sand backfill is considered suitable for support of the floor slab on grade. However, the sand should be densified with vibratory compaction equipment prior to placement of concrete. We recommend that compaction be to a minimum of 95 percent of the maximum dry unit weight as determined by the Standard Proctor Test (ASTM D 698).

Excavation Stability/Dewatering

The subsurface profile at the boring locations to the anticipated excavation depths include deposits of water bearing sand. Excavations extending through these type of deposits generally result in conditions where stable excavation slopes cannot be sustained. Multiple sumps may be required to lower and maintain the water level at elevations required to allow for the construction of the new structure.

In addition to the recommended dewatering procedures, excavation bracing or slopes flat enough to prevent caving of the excavations will be required for protection of workers. Based upon the requirements outlined by the Occupational Safety and Health Administration (OSHA) in 29 CFR Parts 1926.650 through 1926.652, the sand encountered to the expected excavation depth are classified as a Type C Soil. In accordance with OSHA, unprotected slopes in Type C soil cannot be steeper than 1-1/2 horizontal to 1 vertical. It is possible that slopes as flat as 2H:1V will be required in some instances. If site limitations require slopes steeper than those allowed by OSHA, excavation bracing will be required in the overlying soils.
Seismic Class

We have reviewed information regarding the Site Seismic Class considering the soil profile encountered in the borings. Based upon the criteria contained in Table 1613.5.2 of the International Building Code (IBC), we recommend a Site Class of D.

CLOSURE

We recommend that full time site observations and testing be provided by RGE personnel during foundation construction to document that soils capable of achieving the recommended bearing capacity have been encountered at the planned bearing elevation. In addition, monitoring of building materials and fill placement and compaction should be completed to document compliance with the recommended procedures and specifications.

The analysis and recommendations submitted in this report are based upon the data obtained from the two (2) soil borings performed at the locations indicated on the Boring Location Plan. This report does not reflect any variations which may occur beyond these borings, the nature and extent of which may not become evident until during the course of construction. If variations are then identified, the recommendations contained in this report should be re-evaluated after performing on-site observations.

Douglas P. Ramsey
Licensed Professional Engineer
Illinois No. 062-040905
APPENDIX

BORING LOCATION PLAN

BORING LOGS
EXISTING BUILDING

PROPOSED ELEVATOR ADDITION

BENCHMARK IS TOP OF FINISHED FLOOR AT EXISTING DOORWAY
ASSUMED ELEVATION = 100.0

B-1 99.5
B-2 99.6

20' 13'

APPROXIMATE SCALE
1" = 10'

BORING LOCATION PLAN
GEOTECHNICAL EXPLORATION
GROSSINGER ARENA ELEVATOR
ADDITION
BLOOMINGTON, ILLINOIS

RAMSEY GEOTECHNICAL ENGINEERING
1701 W. MARKET STREET, SUITE B
BLOOMINGTON, ILLINOIS 61701

DRAWN BY: MKR
CHECKED BY: DPR
RGE JOB: 17-002
DATE: 11-20-2017
Loose brown fine to coarse SAND (SP)

Very tough brown silty CLAY, trace sand and gravel (CL)

Tough to very tough gray silty CLAY, trace sand and gravel (CL)

End of Boring at 25.0'

* Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.
### Soil Descriptions

- **Loose brown fine to coarse SAND (SP)**
- **Firm brown clayey fine to coarse SAND, trace small gravel (SC)**
- **Very loose brown fine to coarse SAND (SP)**
- **Tough brown silty CLAY, trace sand and gravel (CL)**
- **Tough to very tough gray silty CLAY, trace sand and gravel (CL)**

### Notes
- End of Boring at 40.0'
- Approximate unconfined compressive strength based on measurements with a calibrated pocket penetrometer.
PART 1 - GENERAL

1.1 SECTION SUMMARY

A. Section Includes:
   2. Project description.
   3. Contracts.
   4. Work Restrictions.
   5. Work by Owner.
   7. Drawings and Specifications Formats and Conventions.

B. Related Documents:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
   2. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

1.2 PROJECT DESCRIPTION

A. Project: Bloomington Coliseum Elevator Addition
   101 South Madison Street
   Bloomington, IL 61701

B. Owner: City of Bloomington
   115 East Washington Street
   Bloomington, IL 61702
   Contact: Russ Waller
   Phone: 309-434-2492

C. Architecture, Structural, Mechanical, Electrical Engineering:
   BKV Group Inc.
   343 South Dearborn Street
   Suite 203
   Chicago, IL 60604
   Contact: Craig Carter
   Phone: 312-279-0465

D. Civil Engineering:
   Farnsworth Group
   2709 McGraw Drive
   Bloomington, IL 61704
   Contact: Jeff Gastel
   Phone: 309-663-8435

E. General Project Description: The Scope of Work is a small addition on the south side of the existing Bloomington Coliseum to house a two-stop elevator. The project will provide accessibility from the Concourse Level to the Event Level during concerts and other similar events.
1.3 CONTRACTS

A. Project will be constructed under a general construction contract.

1.4 WORK RESTRICTIONS

A. Contractor's Use of Site and Premises: Contractor will generally have full use of site and premises during construction for execution of the Work. Comply with the following:
   1. Limit use of site and premises to allow for the following.
      a. Work by separate contractors.
      b. Maintain Egress.
      c. Owner occupancy.
      d. Use of site and adjacent premises, including the public as applicable.
   2. Coordinate use of site and premises with the Owner, including designated parking, site and building access, and storage and staging areas.
   3. Move any stored products under Contractor’s control that interfere with the operations of the Owner.
   4. Assume full responsibility for protection and safekeeping of products under this Contract stored on site.
   5. Obtain and pay for use of any additional storage or work areas needed for operations.
   6. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project.

B. Work Hours: Perform construction during working hours as agreed to in advance with Owner.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
   1. Notify Architect and Owner not less than five business days in advance of proposed utility interruptions.
   2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Areas Adjacent to the Project Site: Take measures to restrict work to the project site without disruption to occupants of areas adjacent to the Project site, to ensure safe operations in accordance with the General and Supplementary Conditions, and ensure safe passage of persons using areas adjacent to the Project Site.

E. Driveways and Entrances: Keep driveways and entrances serving premises available to Owner and emergency vehicles at all times. Coordinate areas for parking or storage of materials.
   1. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

F. Establish designated smoking areas. Prohibit smoking within interior spaces.

1.5 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to work in areas indicated on Drawings. Do not disturb portions of Project site beyond areas in which the Work is indicated.
   1. Limits: Confine construction operations to <Insert description of areas where work is permitted>.
C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.6 MISCELLANEOUS PROVISIONS

A. Owner-Furnished, Contractor Installed Products: Owner will furnish certain products. Provide support systems as required to receive Owner's equipment, including plumbing, mechanical, and electrical connections as applicable.
   1. Comply with requirements specified in Section 016000 – Product Requirements.

B. Future Work: Owner may award a separate contract for work to be performed after Substantial Completion. Completion of that work may depend on successful completion of work under this Contract. Future work may include the following:

1.7 DRAWINGS AND SPECIFICATIONS FORMATS AND CONVENTIONS

A. Specifications: The Specifications are organized into Divisions and Sections using the 49-division format and CSI MasterFormat 2004–2010 numbering system.

B. Materials List: A material code designation system is used on the Drawings for cross-referencing materials and products to Specifications Sections.
   1. The material code system is not intended to create a division of the work, nor establish the extent of the work to be performed by a particular trade.
   2. Material abbreviations may be non-sequential. Only material codes indicated are applicable to this Project.

C. Cross-References: Specification Sections containing cross-references to other sections listed under “Specified Elsewhere” are included for convenience. Sections may contain cross references to other sections within the body of spec sections. Contractor shall thoroughly review the specifications and make reasonable inferences as to the location of related work.

D. Precedence: In the case of a conflict between Drawings and Specifications, the Architect will make an interpretation. Refer to Section 012000 – Contract Interpretations and Modifications.

E. Architectural Drawings are diagrammatic, indicating the intended design and aesthetic effects, and may not indicated all detail conditions for this Project. Construct work in architectural profiles, configurations, and finishes indicated, and provide other components, connections and accessories required to produce complete assemblies complying with the design intent and specified work results.
   1. Provide additional construction detailing for conditions not indicated, that comply with the design intent and specified work results.
      a. Produce additional shop drawing details and submit to Architect for approval, if needed to complete the work, or if requested by Architect.
   2. Aesthetic Effects: Do not modify intended aesthetic effects, as determined by Architect, unless approved in writing by Architect.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Release Form for Electronic and CAD Files.

1.2 ELECTRONIC FILES

A. Copies of electronic files from the Architect’s preparation of CAD generated drawings may be provided to the Contractor by the Architect subject to the conditions of this section.

1.3 GENERAL

A. Electronic Files will only be provided to General Contractor only upon receipt of the appropriate fee and a completed copy of the following RELEASE WAIVER FOR THE PREPARATION OF ELECTRONIC FILES.
   1. Subcontractors and others may obtain copies of electronic files from the Prime/General Contractor, subject to the terms of this specification section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)
RELEASE WAIVER FOR THE PREPARATION OF ELECTRONIC FILES

Receipt of this waiver form by BKV Group and fee, is confirmation that electronic file(s), in the Architect’s current version of either AutoCAD drawings or Revit model, and referred to as the electronic file hereafter, have been requested by your organization for sole use by your organization for the project identified below. Upon BKV’s receipt of the release form, signed by your lead representative, BKV Group will begin the work effort toward preparing the electronic files for your use. The preparation of the file will include the extraction of the BKV Group title block, Signature Block and any information deemed to be of a proprietary nature, by BKV Group.

The cost of the effort associated with BKV Group’s preparation of file for distribution to the contractor’s designated FTP site location (or CD/DVD if agreeable to the Architect) is $500.00 per discipline (i.e. Architectural CAD drawings or Revit Model — a request for Architectural, Mechanical, & Structural electronics files would require payment of $1500) and is to be paid for by the contractor and provided with this waver prior to the release of the electronic files. Please forward your payment and a copy of this release to:

Finance Director
BKV Group
222 North Second Street
Minneapolis, MN 55401

* An additional $20.00 recovery fee will be charged for checks which do not clear.

The electronic file is not intended for any uses beyond that which are expressly provided at this time. The file and the information within is not to be used, in any form, or on any project other than:

Bloomington Coliseum Elevator Addition
BKV Group Project Number: 21360.02

Except as noted, the file is not to be provided to any other party without prior, written approval by BKV Group.

1. Copies of the Electronic File may be provided by the Prime/General Contractor to the Prime/General Contractor’s subcontractors for the sole purpose of facilitating the preparation of shop drawings for this project, and subject to the terms of this waiver.

2. Use of the electronic file by any subcontractor constitutes acceptance of the terms of this specification section by that subcontractor.

Signature of this RELEASE FORM constitutes recognition and agreement with the conditions described within and with the following:

1. AutoCAD files included typically convey floor plan information. Revit models will include floor plan information and elevation/section information that was created in conjunction with that plan information. The receiver should not expect to receive an entire electronic replica of the issued hard copy construction drawings. Manipulation of the files may be required depending on the recipient’s intended use of the files.

2. The sole intention of the creation of the electronic file, conveyed with this release, was as instruments of service to be used as drafting tools to produce a hardcopy set of construction documents only and is to be used solely at the contractor’s risk. Such contractor risk is to include the understanding that discrepancies and inaccuracies will exist in the file, as its use is that of a symbolic tool only.
3. The information within the electronic file does not constitute any portion of the contract documents nor does it supersede in any way the information or intent conveyed within the construction documents. Topographic and site information, fixtures, including but not limited to plumbing, doors, equipment, conveyance, and distribution products are merely representational diagrams and shall not be construed as replica of the site condition, product or style of product to be utilized.

4. The contractor, by using the electronic file, shall do so with the understanding that the file will be conveyed to the contractor on a one-time basis only and that any and all changes, which may occur throughout the construction administration process or to the official construction documents, will not be updated to the electronic file.

5. The electronic file is not to be used for material or quantity takeoffs, estimation, fabrication, scheduling, budgeting or any similar acts. All risks associated with utilizing the file in this or any related fashion are the contractors only.

6. Use of the electronic file provided by the Architect does not alleviate the Contractor from the responsibility for the proper check and coordination of elevations, dimensions, details, member or component sizes, quantities or locations and other requirements to fully complete an accurate fabrication and installation of the work. The contractor will still retain the responsibility for maintaining appropriate on-site hard-copy documentation of as-built and existing conditions for transmittal to the Owner and the Architect upon the completion of the construction document, as described within the project specifications.

7. By accepting the electronic file the user covenants not to sue, and agrees to indemnify and hold harmless Architect and Owner from any costs (including Attorney’s fees), claims or causes of action be it tort, breach of contract or otherwise that result from the use of the file.

8. Providing electronic files by the Architect is not to be construed in any manner to be a shared-use or conveyance of the intellectual property rights contained within. Architect maintains the exclusive right to decide not to provide copies of project related intellectual property.

Please indicate your:

REQUESTED DRAWING DISCIPLINE

Architecture: __________
Structural: __________
Mechanical: __________
Electrical: __________
Other: __________

Total Payment Included: _______________________________________

Contractor Company Name: _______________________________________
Contractor Company Address: _______________________________________
Authorized Representative Name: _________________________________
Authorized Representative Signature: _______________________________
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requests for Information/Interpretation.
   2. Claims for adjustments to Contract Sum and Time.
   4. Allowances.
   5. Alternates.
   6. Unit prices.
   7. Contract payment procedures:
      a. Schedule of values.
      b. Applications for payment.
      c. Final payment and change order.

B. Related Sections:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections of the Specifications.

1.2 REQUESTS FOR INFORMATION/INTERPRETATION

A. General: Fully examine the Drawings and Specifications and make reasonable inferences upon the Work included. In the event that project requirements are not reasonably inferable, or not adequately indicated in either the Drawings or the Specifications, submit a written Request for Information/Interpretation (RFI) to the Architect.
   1. Do not use RFI’s to propose product substitutions.

B. Architect will provide interpretations to the Contract Documents. The Architect will respond to a written RFI within a reasonable time frame to avoid delay in the Work, in one of the following methods:
   1. Architect will provide a written response directly on the RFI form on the space provided (no change in cost or time).
   2. Architect will provide supplemental instructions or a field order, where required by a more extensive response (no change in cost or time).
   3. Architect will prepare a proposal request (change in cost or time).

C. Architect will not respond to RFI’s for work that is clearly indicated or reasonably inferable.

D. RFI Forms: Provide a project-standard RFI’s form, complying with the following:
   1. Form shall be on a single page as practicable, and shall represent one RFI corresponding to each separate item of interpretation.
   2. Include the following information:
      a. RFI reference or tracking number,
      b. Drawing sheet reference number.
      c. Specifications reference number.
      d. Other identifying information.
3. Include a space on the form as practicable for Architect’s response, clarification, or interpretation. Architect will provide additional documentation as needed.

4. RFI’s shall be submitted by the General Contractor only, and on behalf of its subcontractors and suppliers.

E. RFI Record: Keep accurate and up-to-date copies of RFI’s, and an RFI log, at the Project site, readily accessible at the Project site.

F. Project Schedule: Allow a reasonable amount of time for Architect’s review of RFI’s in the construction progress schedule.

1.3 CLAIMS FOR ADJUSTMENTS TO CONTRACT SUM OR TIME

A. Contractor's claims shall comply with the following:
   1. Submit initial requests on one of the following standardized forms, as appropriate:
      a. Proposal Request Form.
      b. Change Order Request Form.
   2. Provide clear documentation that the changed condition actually was not foreseeable at the time of bid and resulted in demonstrable changes.
   3. Claims shall be submitted by the General Contractor only, and on behalf of its subcontractors and suppliers

B. Contractor's claims shall be submitted to the Architect in accordance with the General Conditions. Architect will interpret the contract documents, and make an initial decision to determine entitlement. If Contractor or Owner takes exception to the Architect's decision, then the claim may be negotiated, mediated, or arbitrated as provided for in the General Conditions.

1.4 CONTRACT MODIFICATION PROCEDURES

A. Modifications and Project Meetings: Utilize project progress meetings to make Architect and Owner aware of any pending modifications. Give prompt notice to Architect of unforeseen conditions and other matters adversely affecting the progress of the Work.

B. Do not perform additional work for which payment is expected without following specified change procedures, except in cases of emergency work.

C. Proposal Requests: Architect may issue a Proposal Request, on AIA Document G709 Proposal Request, to the Contractor for evaluation of how a proposed change will affect the Contract Sum or Time. Upon receipt, Contractor shall respond to Architect’s Proposal Request with a Change Order Request or Change Proposal.

D. For Contractor initiated Change Order Requests or Change Proposals, comply with the following:
   1. Use a standard form acceptable to Owner and Architect.
   2. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Time. Describe reasons for the change, applicable latent or unforeseen conditions, and the effect of the change on the Work.
   3. Itemize the cost of labor, materials, subcontracts, bonds, insurance, overhead and profit, applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

E. [Approved Proposals] [Change Order Procedure]: Upon Owner's approval of a proposal from Contractor, Architect will issue a Change Order on AIA Document G701, for all changes to the Contract Sum or the Contract Time.
   1. [Specify any additional or special requirements].
F. Minor Changes: For changes not involving adjustment to the Contract Sum or Time, Architect will issue supplemental instructions authorizing minor changes in the Work, on AIA Document G710, "Architect's Supplemental Instructions."

   1. Construction Change Directive will contain a description of the change and designate the method to be followed to determine changes to the Contract Sum or the Contract Time.
   2. Construction Change Directives will not be valid without authorization by Owner.
   3. After authorization, the Work change shall proceed, and be included in a subsequent Change Order.

H. Product Substitutions: Refer to Section 016000 – Product Requirements.

1.5 ALLOWANCES

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

B. Submittals for Allowances: Specified in Section 013000 – Administrative Requirements.

C. Cash Allowances:
   1. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, less applicable trade discounts; delivery to site and applicable taxes.
   2. Costs Not Included in Cash Allowances But Included in Contract Sum/Price: Product handling at site, including unloading, uncrating, and storage; protection of products from elements and from damage; [and] [labor for installation and finishing;] [______].
   3. Architect will perform the following:
      a. Consult with Contractor for consideration and selection of products, suppliers, and installers as required to define required work results and design intent.
      b. Select products in consultation with Owner and transmit decision to Contractor.
      c. Prepare Change Order.
   4. Contractor Responsibilities:
      a. Obtain proposals from suppliers and installers and offer recommendations.
      b. On notification of selection by [Architect] [Owner,] execute purchase agreement with designated supplier [and installer].
      c. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
      d. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
   5. Differences in costs will be adjusted by Change Order.
   6. Schedule of Cash Allowances:
      a. Testing.

D. Contingency Allowances:
   1. Include in the Contract, a stipulated sum/price of $[Specify] for use upon Owner's instruction.
   2. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.
   3. Funds will be drawn from Contingency Allowance only by Change Order.
4. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

E. Testing and Inspection Allowance:
   1. Costs Included in Testing and Inspecting Allowances: Cost of engaging testing and inspecting agency; execution of tests and inspecting; and reporting results.
   2. Costs Not Included in Testing and Inspecting Allowance But Included in Contract Sum/Price:
      a. Costs of incidental labor and facilities required to assist testing / inspecting agency.
      b. Costs of testing services used by Contractor separate from Contract Document requirements.
      c. Costs of retesting upon failure of previous tests as determined by Architect.
   3. Payment Procedures:
      a. Submit copies of inspecting or testing firm's invoice with next application for payment.
      b. Pay invoice on approval by Architect.
   4. Testing and Inspecting Allowances Schedule:
      a. [Specify].
   5. Differences in cost will be adjusted by Change Order.

1.6 ALTERNATES
   A. Alternates: An alternate is an amount proposed by bidder for certain work that may be added to or deducted from the Base Bid amount if Owner accepts the Alternate. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.
   B. Schedule of Alternates: Indicate amounts to be added to the Contract Sum for the following alternates:
      1. Alternate No.1: [Title].

1.7 UNIT PRICES
   A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.
   B. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
   C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
   D. Schedule of Unit Prices:
      1. Unit Price No.1: [Title].

1.8 PAYMENT PROCEDURES
   A. Schedule of Values: Submit a Schedule of Values to Architect with preconstruction submittals specified in Section 013000 – Administrative Requirements; and corresponding to each application for payment.
1. Submit the Schedule after the award of the contract, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

2. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

3. Format and Content: Develop a proportionate Schedule of Values. Use the Specifications table of contents as a guide to establish line items. Provide separate line items in the Schedule of Values for general conditions and overhead items.

4. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

B. Applications For Payment: Submit Applications for Payment to Architect for review and certification.

1. Architect will certify and recommend payment only the amount having a sound contractual basis for payment.


3. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

4. Payment Application Interval: Payment Interval shall be monthly, starting from the beginning of a calendar month to the end of that month. The date for each progress payment shall be the 10th day of each month. The period covered by each Application for Payment shall be for work performed for the preceding calendar month.

5. Record Documents: Contractor shall each month show evidence that Record Documents are being properly maintained.

6. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
   a. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
   b. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
      1) Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
      2) When an application shows completion of an item, submit final or full waivers.
      3) Owner reserves the right to designate which entities involved in the Work must submit waivers.
      4) Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

7. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   a. List of subcontractors.
   b. Schedule of Values.
   c. Contractor's Construction Schedule (preliminary if not final).
   d. Submittals Schedule (preliminary if not final).
   e. List of Contractor's staff assignments.
   f. Copies of building permits.
g. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.

h. Certificates of insurance and insurance policies.

i. Performance and payment bonds.

j. Data needed to acquire Owner's insurance.

8. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100-percent completion for portion of the Work claimed as substantially complete.

9. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   
a. Evidence of completion of Project closeout requirements.
   
b. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   
c. Updated final statement, accounting for final changes to the Contract Sum.
   
d. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   
e. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
   
f. AIA Document G707, "Consent of Surety to Final Payment."
   
g. Evidence that claims have been settled.
   
h. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

C. Final Change Order: Prepare a final change order to balance previous payments against final payment and final contract amount. Include any adjustments for allowances and other items.

D. Final Payment: Neither progress payments, nor acknowledgement of substantial completion or partial occupancy constitute acceptance of work not completed according to the Contract Documents.

1. Architect will recommend final payment only after all project closeout procedures have been completed in accordance with requirements indicated in Section 017000 – Execution and Closeout Requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Project meetings.
   2. Construction coordination.
   3. Coordination drawings.
   4. Submittals procedures, including:
      a. General submittals procedures.
      b. Pre-construction submittals.
      c. Construction action submittals.
      d. Construction informational submittals.
      e. Close-out submittals.
      f. Submittals for Allowances.
   5. Construction progress documentation.

B. Related Sections:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections of the Specifications.

1.2 PROJECT MEETINGS

A. General: Conduct meetings at the Project site to facilitate coordination of the Work, resolve issues, exchange information, and make decisions.

B. Preconstruction Conference: Schedule and convene preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

   1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference.
   2. Agenda: Discuss items of significance that could affect progress, including the following:
      a. Regulatory requirements.
      b. Tentative construction schedule.
      c. Critical work sequencing.
      d. Designation of responsible personnel.
      e. Distribution of the Contract Documents.
      f. Procedures specified in Division 01 Sections including:
         1) Price and payment procedures, contract modifications, and applications for payment.
         2) Administrative procedures, including meetings and submittals.
         3) Execution and closeout procedures, including Record Documents.
      g. Use of the premises.
h. Responsibilities for temporary facilities and controls.
i. Parking and access.
j. Office, work, and storage areas.
k. Equipment deliveries and priorities.
l. First aid.
m. Security.
n. Progress cleaning.
o. Working hours.

C. Periodic Progress Meetings: Conduct progress meetings at regular intervals. Coordinate dates of meetings with preparation of payment requests and Architect’s periodic site visits.
   1. Notify Owner and Architect of meeting dates and times. Require attendance of each subcontractor or other entity concerned with current progress or involved with planning or coordination of future activities.
   2. Architect will visit the site at regular intervals.

D. Preinstallation Meetings: Conduct preinstallation meetings where indicated in individual specification sections to clarify installation procedures, phasing, and coordination of the work.
   1. Convene the meeting at least one week prior to installation. Notify Architect and other participants of meeting dates.
   2. Make readily available necessary information such as approved submittals, drawings, and specifications.
   3. Attendees: Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturer’s representative; suppliers; and other concerned parties shall attend the conference.
   4. Agenda: Discuss items of significance, including the following:
      a. Access to work and conditions of proper installation.
      b. Review conditions of installation, such as substrates, existing and surrounding conditions, and environmental conditions
      c. Identify conditions detrimental to the installation.
      d. Review preparation procedures, including protection of adjacent work.
      e. Verify installer’s receipt and understanding of installation instructions.
      f. Review submittals, installation procedures, and sequences.
      g. Review coordination with other work.
      h. Evaluate delivery schedule and progress schedule.
      i. Observe a sample installation.
      j. Convey required protection procedures.
      k. Evaluate, document, and approve field mock-ups.

E. Closeout Meeting: Specified in Section 017000 – Execution & Closeout Requirements.

F. Post-Construction Warranty Meeting: Conduct meeting with the Owner at time specified below for the purpose of review of warranties, bonds, and service and maintenance contracts for material and equipment.
   1. Conduct meeting at 11-months after Substantial Completion.
   2. Take action as appropriate to implement, repair, or replace defective items, and to extend service and maintenance contracts.
1.3 CONSTRUCTION COORDINATION

A. Coordinate construction to ensure efficient and orderly installation of each part of the Work. Coordinate and make adjustments to work of various subcontracts and work adjacent to and adjoining each other as required to produce proper fit, joinery, and transitions.

B. Sequencing: Coordinate construction operations as required to properly sequence the Work to achieve complete, finished installation.

C. Specification Sections: Coordinate construction indicated in separate Specifications Sections, and Sections that are depend on other Sections, to ensure efficient and orderly installation of each part of the Work, and proper installation, connection, and operation.

D. Furnish each subcontractor copies of all Contract Documents that apply to the work performed under that subcontract.

E. When Contract Documents require that installation of Work shall comply with manufacturer’s printed instructions, Contractor shall obtain and distribute copies of such instructions to parties involved in the installation. Maintain one set of complete instructions at the jobsite during installation through completion.

1.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prior to commencement of Work, prepare coordination drawings as required to define relationship of mechanical, plumbing, fire protection, and electrical components with beams, columns, ceilings and walls.

B. Hold coordination meetings with trades providing mechanical, plumbing, fire protection, and electrical work. Resolve conflicts between trades, prepare composite coordination drawings and obtain signatures on original composite coordination Drawings.
   1. When conflicts cannot be resolved, temporarily discontinue work in areas of conflict and request clarification prior to proceeding, and prepare drawings to define and to indicate proposed solution.
   2. Submit drawings for approval when actual measurements and analysis of Drawings and Project Manual indicate that various systems cannot be installed without significant deviation from intent of Contract Documents.

C. Submit composite coordination drawings as part of Project Record Documents specified in Section 017000.
   1. Submit, for information only, electronically in Adobe PDF format.
   2. Include plans, elevations, sections, and details required to define relationships between components.
   3. Prepare drawings at 1/4 inch = 1'-0" scale for general layout and 3/8 inch = 1'-0" for plans and sections in congested areas including equipment spaces.

1.5 SUBMITTAL PROCEDURES, GENERAL

A. Contractor shall not perform any work requiring submittal and review of shop drawings, product data, and samples, without review and approval by the Architect. Work performed shall be in accordance with approved submittals.

B. Electronic Submittals: The preferred format for submittals other than physical and color samples is electronic PDF, using [Architect's][Contractor's own][Owner's] web-based information exchange [name], made available to Contractor free of charge.
   1. [Name of Program]: Obtain access information from Architect.
2. Where electronic submittals cannot be made, make paper copy submittals specified in this Section.

C. Submittal Transmittal: Make submittals with transmittal form included as Section 013011 – Submittal Transmittal.

D. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

E. Contractor’s Review and Preparation of Submittals: Comply with the following:

1. Contractor’s Initial Review: Submittals shall be initially reviewed and approved by the General Contractor, prior to sending on to Architect. Check submittal content, dimensions, and coordinate with subcontractors as necessary to ensure that contract requirements have been met. Identify deviations from the Contract Documents.

2. Submit minimum 4-copies of each submittal, unless noted otherwise.

3. Place a permanent label or title block on each submittal for identification. Provide a 4-inch by 5-inch space on the label or beside title block to record review and approval markings and action taken. Include the following information on the label:
   a. Project name.
   b. Date.
   c. Name and address of Contractor.
   d. Name and address of subcontractor or supplier.
   e. Number and title of appropriate Specification Section.

F. Architect’s Review of Submittals: Architect will review submittals to determine whether the submittal is consistent with the design intent and the Contract Documents; and not to determine accuracy and completeness of dimensions or quantities.

1. Architect will only accept submittals from the General Contractor.

2. Submittals not properly reviewed and approved prior to submitting for Architect’s review may be returned.

3. Do not submit submittals that are not required for review. Submittals not required will be returned without review to the contractor, with an annotation “not required for review”.

4. Informational Submittals: Information submittals not requiring approval will not be returned to Contractor. Architect will review informational submittal to verify compliance with the Contract Documents, and will notify Contractor if submitted item does not comply. If submitted item does not comply, then resubmit as directed by Architect.

5. Action Submittals: Architect will review each action submittal, mark as appropriate to indicate action taken, and return copies less those retained. Compliance with specified requirements remains Contractor’s responsibility.

6. Initial Review: Allow 15-days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

7. Resubmittal Review: Allow 15-days for review of each resubmittal.

G. Review of Submittals by Architect’s Consultants:

1. Sequential Review: Where sequential review of submittals by Architect’s consultants, allow 21-days for initial review of each submittal.

2. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
1.6 PRE-CONSTRUCTION SUBMITTALS

A. Unless noted otherwise, no work shall begin until all required preconstruction submittals have been submitted by the Contractor, and reviewed and approved by the Architect and Owner's.

B. Contractor’s Quality Review Acknowledgement: Specified in Section 014000 – Quality Requirements.

C. Contractor’s Temporary Facilities and Controls: Submit a detailed work plan or specifications for Contractor’s temporary facilities and controls. Coordinate work plan with Owner, utilities, and regulatory authorities.
   1. Include special requirements related to conditions of this Project.
   2. Include the following topics:
      a. Temporary utilities, including electricity, lighting, heat, ventilation, telephone, fax, and computer services, water, sanitary facilities.
         1) Indicate utility sources and payment responsibilities.
      b. Field offices and sheds.
      c. Temporary controls.
      d. Protection of installed Work.
      e. Security.
      f. Progress cleaning.
      g. Water, erosion, sediment, dust, and mold and mildew control.
      h. Access roads and parking areas.
      i. Removal.

D. Construction Waste Management: Comply with requirements in Section 017419.

E. Certificates of Insurance: Submit required certificates of insurance indicated in the Supplementary Conditions on a standardized form, such as ACORD or AIA Document G715. Architect will review certificates only for conformance with administrative contract requirements, including proper form, dates of coverage, and required signatures. Owner will make final review of compliance in consultation with their legal counsel and insurance advisors.

F. Surety Bond: Submit required bonds indicated in the Supplementary Conditions on a standardized form, such as AIA Document A312. Architect will review certificates only for conformance with administrative contract requirements, including proper form, dates, and required signatures. Owner will make final review of compliance in consultation with their legal counsel and insurance advisors.

G. Subcontractor and Major Material Suppliers List: Prepare a written summary identifying individuals or firms proposed for (only) major portions of the Work. Use CSI Form 1.5A, or another form acceptable to Architect and Owner.

H. Construction Schedule: Prepare a horizontal bar-chart Contractor’s construction schedule.
   1. Provide a separate time bar for each activity, using same breakdown of Work indicated in the Schedule of Values, and a vertical line to identify the first workday of each week.
   2. Indicate pre-installation meetings where applicable.
   3. Coordinate each element with other activities. Show each activity in proper sequence. Indicate sequences necessary for completion of related Work.
   4. Indicate milestones, Substantial Completion, Final Completion, and allow time for Architect’s procedures necessary for certifying Substantial Completion.
   5. Construction Schedule Submittal Procedure:
a. Distribute copies to Owner, Architect, subcontractors, and parties required to comply with dates.
b. Revise the schedule after each meeting or activity where revisions have been made. As Work progresses, mark each bar to indicate actual completion. Distribute revised copies to Owner, Architect, subcontractors, and parties required to comply with dates.

I. Schedule of Values: Submit Schedule of Values complying with Section 012000 – Price and Payment Procedures.

1.7 CONSTRUCTION ACTION SUBMITTALS

A. General: Provide action submittals specified in individual Specification Sections.

B. Shop Drawings: Submit Project-specific information drawn to scale. Do not base Shop Drawings on reproductions of the Contract Documents, nor standard printed data.
   1. Include the following:
      a. Dimensions, profiles, methods of attachment, large scale details, and other information, as appropriate for the Work.
      b. Identification of products and materials.
      c. Notation of coordination requirements.
      d. Notation of dimensions established by field measurement.
   2. If electronic submittals cannot be provided, submit 6-copies black-line print on sheets at least 11-inches by 17 inches, but no larger than 36 inches by 48 inches. Architect will retain two print copies and return remaining copies, unless otherwise noted.

C. Product Data: Mark each copy to show applicable choices and options. Include the following:
   1. Data indicating compliance with specified standards and requirements.
   2. Notation of coordination requirements.
   3. For equipment data, include rated capacities, dimensions, weights, required clearances, and furnished specialties and accessories.

D. Samples: Submit Samples finished as specified and identical with the material proposed. Comply with the following:
   1. Attach label on the unexposed side of Samples that includes the following:
      a. Generic description of Sample.
      b. Manufacturer and model, model number.
      c. Number and title of applicable Specification Section.
      d. Sample source.
   2. Where variations are inherent in the material, submit sufficient units to show full range of the variations.
   3. Architect will review samples for kind, color, pattern, and texture characteristics with other elements, and for a comparison of these characteristics between submittal and actual component as delivered and installed.
   4. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
   5. Maintain sets of approved Samples at Project site, available throughout the course of construction activity.
   6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available. Architect will return submittal with options selected.
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected.

1.8 CONSTRUCTION INFORMATION SUBMITTALS

A. General: Provide informational submittals specified in individual Specification Sections.

B. Manufacturer Product Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

C. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

D. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

E. Operation And Maintenance Data: Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections. Where applicable, organize and bind operation and maintenance data into suitable sets of manageable size.

F. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

G. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
   1. Name, address, and telephone number of factory-authorized service representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Other required items indicated in individual Specification Sections.

1.9 CLOSE-OUT SUBMITTALS

A. Refer to Section 017000 – Execution and Closeout Requirements for detailed requirements during project closeout.

B. Refer to individual Sections in Division 02 through 33 for specific submittal requirements applicable to construction products.

1.10 CONSTRUCTION PROGRESS DOCUMENTATION

A. Construction Schedule: Submit initial construction schedule prior to start of construction as specified in this Section. Update construction schedule at monthly intervals, reflecting actual construction progress and activities. Issue schedule before each regularly scheduled progress meeting. Post copies in Project meeting rooms and temporary field offices.
B. Construction Photographs: Take daily routine construction photographs on digital media to record construction progress. Record dates of photographs, and maintain secure electronic files in field office and main office locations. Make construction photographs available to Owner and Architect.

C. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
   1. Contractor’s project number.
   2. List of subcontractors at Project site.
   3. High and low temperatures and general weather conditions.
   4. Project schedule review, adjustments and variations, including Change Orders, and Construction Change Directives, and minor changes.
   5. Orders and requests of authorities having jurisdiction.
   6. Services connected and disconnected.
   7. Equipment or system tests and startups.
   8. Partial Completions and occupancies.

D. Record Documents: Refer to requirements in Section 017000.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF SUBMITTALS

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Regulatory Requirements.
   2. References.
   3. Quality assurance.
   4. Mockups.
   5. Quality control.
B. Related Sections:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
   2. Section 014100 - Special Inspection and Tests, for code-required testing and inspection.

1.2 DEFINITIONS
A. Quality: Features and characteristics of the Project, including products and services, pertaining to the ability to satisfy stated and implied requirements established in the Contract Documents.
B. Quality Assurance: Procedures for guarding against defects and deficiencies before and during the execution of the work.
C. Quality Control: Procedures for evaluating completed activities and elements of the work for conformance with contract requirements.
D. Successful Experience: When specified as qualifications of a firm, "successful experience" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction

1.3 SUBMITTALS
A. Contractor’s Quality Review Acknowledgement: Submit on Contractor’s letterhead a statement that Contractor has reviewed the Drawings and the Specifications; and has compared the contract documents to one another and field conditions under which work will be performed; and compared conditions found on site with the requirements of the Contract Documents.
   1. Refer to Section 013000 – Administrative Requirements, for other preconstruction submittals.

1.4 REGULATORY REQUIREMENTS
A. Building Codes: Specified codes are applicable to this Project. Obtain copies of codes, retain at Project site, and make available for reference.
   1. Refer to Drawing G001.
B. Building Inspections: Authorities having jurisdiction will conduct inspections during construction, as required by code.
   1. Schedule and coordinate all work required for city inspections. Pay all fees, and provide timely notices to others when inspections are scheduled to be made.
C. Special Permits: Obtain special permits listed below as provided by Contractor. Certain other permits listed below are provide by Owner. Provide related services, and cooperate with Owner in conjunction with special permits provided by Owner.
   1. Coordinate work related to Owner’s special permits for this Project. Request and obtain sufficient information from Owner about the Owner’s special permits. If information is insufficient, notify Owner and Architect.
   2. Take measures to ensure proper performance of the Work under this Contract as it relates to and interfaces with special permits provided by Owner.
   3. Access: Provide reasonable access to the Work affected by Owner’s special permits.

1.5 REFERENCES
A. General: The current edition or publication of references shall be used, unless noted otherwise.
B. Industry Standard References: Individual Specification Sections specify industry construction reference standards as applicable to the work of the particular Section.

1.6 QUALITY ASSURANCE
A. General: Comply with the following general quality requirements:
   1. Construction Operations: Supervise and direct the work using Contractor’s own expertise, skill, and attention; and assume control over the means, methods, techniques, sequences, and procedures for construction.
   2. Subcontractors: Engage subcontractors with proper qualifications and expertise in particular trades and special product types to assure project quality.
   3. Examination: Prior to construction, visit the site to become fully familiar with conditions under which work will be performed, and compare conditions with the requirements of the Contract Documents.
      a. Compare the Contract Documents with each other and with site conditions, and correlate proposed construction solutions with the requirements of the Contract Documents.
      b. Report to the Architect any conflicts, errors, ambiguities, or discrepancies.
   4. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services. Minimize delay and avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   5. Miscellaneous Services: Cooperate with testing agencies and provide miscellaneous services, including access to the work, incidental labor and facilities, adequate quantities of materials for testing, and assistance in taking samples, facilities for storing and curing test samples, and security and protection as necessary for samples and test equipment.

B. Architect: Architect will perform or provide the following in regard to quality:
   1. Observation: Architect will periodically visit the site, become familiar with the progress and observe the quality of the work, and will endeavor to guard the Owner against defects and deficiencies in the work, in accordance with the General Conditions.
      a. Architect shall not be required to perform inspections, except to determine the dates of substantial completion and final completion.
   2. Architect will act as interpreter of the Contract Documents and provide continuity and understanding of the intent of the Contract Documents; and will provide information to clarify the design intent, including those that necessitate contract modifications. Refer to Section 012000 – Price and Payment Procedures.
   3. Architect shall have the authority to reject work that does not comply with the Contract Documents; and to require additional independent testing or inspection.
C. Quality Assurance Measures: Individual Specification Sections contain detailed or special quality assurance requirements indicated below, as applicable to the work of the particular Section:

1. Regulatory Requirements: Where specified, provide products or construction complying with regulatory requirements of building authorities and regulatory agencies.
2. Engineering Design: Where specified, engage a qualified professional to provide design services of special product components, systems or assemblies, as required to comply with specified performance and design criteria.
   a. Provide any signatures, certifications, and other submittals specified, and as required to properly execute the Work.
3. Qualifications: Where specified, engage firms meeting minimum expertise and capabilities of manufacturers, fabricators, installers, or other specialists indicated.
   a. Provide any certifications, qualification data, and other submittals specified.
4. Field Samples: Where specified, provide partial applications of finish samples used to establish a minimum standard of workmanship.
5. Mock-Ups: Where specified, provide partial, full-scale construction of work to assure construction quality, and establishing standards by which workmanship will be judged. Mockups may also be used for testing.
6. Pre-installation Meetings: Conduct pre-installation meetings where specified for complex items requiring coordination among project participants. Refer to Section 013000 – Administrative Requirements.

1.7 MOCKUPS

A. Mockups: Mockups are field samples constructed, applied, or assembled at the project site for review by the Owner and Architect that illustrate materials, equipment, or workmanship. Approved mockups establish the standard of quality by which the Work will be judged.

B. Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, then as directed by Architect.
   2. Notify Architect seven days in advance of dates and times when mockups will be constructed. Allow seven days for initial review and each re-review of each mockup.
   3. Employ supervisory personnel to oversee mockup construction. Employ workers that will be employed during the construction at the Project.
   4. Demonstrate the proposed range of aesthetic effects and workmanship.
   5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
   6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

C. Removal:
   1. Mockups may remain as part of the Work only when so designated in individual specification sections.
   2. Do not remove mockups until removal is approved by Architect or upon Final Completion.
   3. Where mockup is not permitted to remain as part of the Work, clear area after removal of mockup has been approved by Architect.
1.8 QUALITY CONTROL

A. Quality Control Measures: Individual Specification Sections contain detailed or special quality control requirements indicated below, as applicable to the work of the particular Section:

1. Source Quality Control: Where specified, provide products, fabrications, or materials complying with quality requirements applicable to products, fabrications, or materials at the point of manufacture or supply.

2. Manufacturer’s Field Services: Where specified, provide services of the manufacturer’s authorized representatives to provide one or more of the services listed below. Submit any field reports as specified.
   a. Instruct installers in the proper installation of a material.
   b. Instruct Owner’s personnel in the proper operation of specialized equipment.
   c. Verify compliance with manufacturer’s instructions.

3. Field Tolerances: Where specified, install work within specified tolerances. If tolerances are not specified, install work within tolerances of industry-established acceptable range of deviation. Verification of dimensional tolerances may be required if deviations appear unacceptable.

4. Field Testing and Inspection: Where specified, provide field testing and inspection by Contractor’s subcontractors engaged in the work, an independent testing and inspection services, or by Contractor’s own forces.
   a. Provide any reports and other submittals specified.

B. Contractor’s Independent Testing and Inspection: Where Contractor provides its own independent testing and inspection services, comply with the following:

1. Make all arrangements, pay the costs, notify testing agency, and provide timely notices to others when inspections and tests are scheduled to be made.

2. Submit certificates of testing, inspection, and approvals that are secured by the Contractor, and deliver to Architect.

3. Testing and Inspection Agency Qualifications: An independent agency that specialize in the types of inspections and tests to be performed, and are acceptable to authorities having jurisdiction.
   a. Testing agency shall cooperate with Architect and Contractor in performing its duties, provide qualified personnel to perform inspections and tests, and shall promptly notify Architect and Contractor of deficiencies in the work.
   b. Agency shall not release, revoke, alter, or enlarge requirements of the Contract Documents nor approve or accept any portion of the Work, and shall not perform duties of Contractor.

4. Inspection and Testing Reports: Include the following:
   a. Name, address, and telephone number of testing agency.
   b. Project title and testing agency’s project number.
   c. Date of report and designation (number).
   d. Dates and locations where samples were taken or inspections and field tests made.
   e. Ambient conditions at the time of sample taking and inspecting or field testing.
   f. Names of individuals taking the sample or making the inspection or test.
   g. Product and test method.
   h. Inspection or test data including interpretation of test results and comments or professional opinion on whether inspected or tested Work complies with requirements.
   i. Recommendations on retesting or re-inspection.
   j. Name and signature of laboratory inspector.
5. Retesting and Re-inspecting: Contractor shall pay for additional testing and inspecting required as a result of tests and inspections indicating noncompliance with requirements.

1.9 STRUCTURAL TESTING AND SPECIAL INSPECTIONS

A. Refer to Section 014100 – Special Inspections and Tests.

B. Contractor will engage a qualified testing agency to conduct structural tests and special inspections in accordance with applicable code, requirements of state and local authorities having jurisdiction. Testing agency’s work will include the following:
   1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
   2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
   3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, with copy to Contractor and to authorities having jurisdiction.
   4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
   5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
   6. Retesting and re-inspecting corrected work.

C. Provide related services as required for structural tests and special inspections. Coordinate, and make requests and notifications to design professionals and building officials when work is ready for inspection.

D. Provide Contractor’s Statement of Responsibility in accordance with applicable code.

E. Detailed requirements for structural testing and special inspection are indicated on Structural Drawing notations. Structural Testing and Special Inspections include categories as follows:
   1. Inspection of fabricators.
   2. Inspections related to steel construction.
   3. Inspections related to concrete construction.
   4. Inspections related to masonry construction.
   5. Inspections related to soils.
   6. Inspections related to sprayed fire-resistant materials.
   7. Inspections related to special cases as required by building officials.
   8. Inspections related to smoke control.
   9. Inspections related seismic resistance of structural steel, cold-formed metal framing, pier foundations, and mechanical and electrical components.
  10. Structural testing related to seismic resistance of masonry, seismic-force-resisting systems; architectural, mechanical and electrical components; reinforcing steel, and structural steel.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION
**PART 1 - GENERAL**

**1.1 SUMMARY**

A. This Section includes requirements for the following:
   1. Inspections by building officials.
   2. Structural tests and inspections.
   3. Special inspections.

B. Related Documents:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

**1.2 INTENT AND CONDITIONS**

A. Intent
   1. Define and coordinate special inspections and tests services.
   2. Define and coordinate conventional testing and inspection services.
   3. Provide greater confidence that the specified work is constructed in compliance with the contract documents and Chapter 17 of the 2015 International Building Code.
   4. Testing and Inspection services are intended to assist in determining probable compliance of the work with requirements specified. These services do not relieve the Contractor of responsibility for compliance with the requirements of the contract documents.

B. Conditions
   1. If inspection of fabricator’s work is required, the Owner's representative may require testing and inspection of the work at the plant, before shipment. Owner, Architect and Structural Engineer of Record (SER) reserve the right to reject material not complying with the contract documents.
   2. Testing and inspection shall be performed in accordance with the industry standard used as the reference for the specific material or procedure unless other criteria are specified. In the absence of a referenced standard, tests shall be accomplished in accordance with generally accepted industry standards.
   3. Work shall be checked as it progresses, but failure to detect any defective work or materials shall in no way prevent later rejection if defective work or materials are discovered, nor shall it obligate Owner to accept such work.

**1.3 RELATED REQUIREMENTS**

A. Refer to PART 2 for technical scope sections regarding specific qualifications, inspections, tests, frequency and standards required.

**1.4 DEFINITIONS**

A. Testing – Evaluation of systems, primarily requiring physical manipulation and analysis of materials, in accordance with approved standards.

B. Inspection – Evaluation of systems, primarily requiring observation and engineering judgment.
C. Special Inspections and Tests – Special Inspections and Tests Services herein include items required by the IBC and other items which in the professional judgment of the Structural Engineer of Record, are critical to the integrity of the building structure.

D. Architect of Record – The prime consultant in charge of overall design and coordination of the project.

E. Structural Engineer of Record (SER) – The Licensed Engineer in responsible charge of the structural design for the project.

F. Licensed Structural Engineer: – A professional engineer with education and experience in the design of structures similar to this project licensed to practice in the state in which the project is located.

G. Testing Agency (TA) – The properly qualified firm performing testing services.

H. Special Inspector (SI) – A properly qualified individual or firm performing special inspections.

I. Building Official – The Officer or his duly authorized representative charged with the administration and enforcement of the Minnesota State Building Code.

J. Continuous – The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

K. Periodic – The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

1.5 REFERENCES

A. International Building Code (Edition as adopted by the Authority having Jurisdiction)

1.6 STRUCTURAL TESTS AND SPECIAL INSPECTIONS

A. Contractor will engage a qualified testing agency to conduct structural tests and special inspections in accordance with Chapter 17 of the International Building Code, requirements of state and local authorities having jurisdiction. Testing agency’s work will include the following:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.

2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, with copy to Contractor and to authorities having jurisdiction.

4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.

6. Retesting and re-inspecting corrected work.

B. Provide related services as required for structural tests and special inspections. Coordinate, and make requests and notifications to design professionals and building officials when work is ready for inspection.

C. Provide Contractor’s Statement of Responsibility in accordance with Section 1706 of the International Building Code.

A. Special Inspections and Tests for this Project include categories as follows:
1. Steel construction.
2. Concrete construction.
5. Helical pile foundations.
6. Wind resistance, special inspections.
7. Seismic resistance, special inspections.
8. Seismic resistance, testing and qualification.
9. Sprayed fire-resistant materials.
11. Fire-resistant penetrations and joints.
12. Smoke control, special inspections.
13. Fire-resistant penetrations and joints.
14. Inspections related to the following special cases as required by building officials.

1.7 QUALITY ASSURANCE

A. Testing Agency (TA) Qualifications: The testing agency shall be an approved independent testing agency acceptable to the Owner, Architect, SER and as noted below:
   1. Authorized to operate in the state in which the project is located and experienced with the requirements and testing methods specified in the technical scope sections of PART 2.
   2. Meeting applicable requirements of Section 1.04 "References".
   3. Testing equipment shall be calibrated at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards, or to accepted values of natural physical constants.

B. Special Inspector (SI) – The special inspector shall be under the direct supervision of a registered civil/structural engineer, experienced with the type of work requiring special inspections and tests.
   1. The categories of special inspector are:
      b. Special Inspector - Structural I and II: Preferably an employee of the SER's firm.
   2. Unique special inspector requirements, for specific materials and system, are noted in related technical specification sections.

1.8 RESPONSIBILITIES

A. Special Inspections and Tests.
   1. Special Inspectors:
      a. Sign the Special Inspections and Tests Summary Schedule in conjunction with other responsible parties prior to commencement of construction.
      b. If requested, attend a pre-construction meeting to review the scope of special inspections and tests.
      c. Use the approved design drawings and specifications, supplemented by the approved shop drawings for review of the work.
      d. Test and/or inspect the work assigned for conformance with the building department approved design drawings, specifications and applicable material and workmanship provisions of the Code. Perform testing and inspection in a timely manner to avoid delay of work.
e. Bring discrepancies to the immediate attention of the contractor for correction, confirm that they are corrected and, if uncorrected after a reasonable period of time, bring to the attention of the Structural Engineer of Record, the Building Official, and to the Architect.

f. Submit test and/or inspection reports to the Building Official, Contractor, the Structural Engineer of Record, and other designated persons in accordance with the Special Inspections and Tests Summary Schedule.

g. Submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved plans, specifications and the applicable workmanship provisions of the Code.

2. Testing Agency:
   a. Sign the Special Inspections and Tests Summary Schedule in conjunction with other responsible parties prior to commencement of construction.
   b. If requested, attend a pre-construction meeting to review the scope of special inspections and tests.
   c. When engaged as a special inspector, provide special inspections and tests services as previously described.

3. Architect of Record (or other prime consultant):
   a. Complete and sign the Special Inspections and Tests Summary Schedule in conjunction with other responsible parties prior to commencement of construction. Provide a completed copy of the schedule to all signed parties including Building Official.
   b. Provide special inspector with approved design drawings, specifications and approved shop drawings.
   c. If appropriate, arrange and attend a pre-construction meeting to review the scope of special inspections and tests. Include Contractor, Building Official, SER, Testing Agency and other parties concerned.
   d. Coordinate the flow of reports and related information to expedite resolution of construction issues.

4. Structural Engineer of Record (SER):
   a. Identify items requiring special inspections and tests including special cases.
   b. Define "type" of special inspector required for "description" of work indicated on the special inspections and tests schedule.
   c. Complete and sign the Structural Inspections and Tests Summary Schedule prior to commencement of construction.
   d. If requested, attend a pre-construction meeting to review the scope of special inspections and tests.
   e. Review reports submitted by special inspectors.
   f. If engaged as a special inspector, provide special inspections and tests services as previously described.

5. Contractor:
   a. Sign the Special Inspections and Tests Summary Schedule in conjunction with other responsible parties prior to commencement of construction.
   b. If requested, attend a pre-construction meeting to review the scope of special inspections and tests.
   c. Post or make available the Special Inspections and Tests Summary Schedule within its office at the job site. Also, provide adequate notification to those parties designated on the schedule so they may properly prepare for and schedule their work.
d. Provide the special inspectors access to the approved design drawings, approved shop drawings and specifications at the job site.

e. Review reports submitted by special inspectors.

f. Retain at the job site all reports submitted by the special inspectors for review by the building official upon request.

g. Correct in a timely manner, deficiencies identified in inspection and/or testing reports.

h. Provide the special inspector safe access to the work requiring inspection and/or testing.

i. Provide labor and facilities to provide access to the work and to obtain, handle and deliver samples, to facilitate testing and inspection and for storage and curing of test samples.

j. Verification of conformance of the work within specified construction tolerances is solely the Contractor’s responsibility.

6. Fabricator:
   a. Sign the Special Inspections and Tests Summary Schedule in conjunction with other responsible parties prior to commencing construction.

   b. Submit a Certificate of Compliance to the Building Official, Special Inspector, and Structural Engineer of Record that the work was performed in accordance with the approved plans and specifications.

7. Building Official (Typical responsibilities noted for information only):
   a. Determine work, which in the Building Officials opinion, involves unusual hazards or conditions in accordance with the IBC.

   b. Review special inspector qualifications.

   c. Accept and sign the completed Special Inspections and Tests Summary Schedule.

   d. Review all fabricators who perform work in their shop, which requires special inspection.

   e. Review reports and recommendations submitted by the special inspectors.

   f. Review the “final signed reports” submitted by the special inspector(s). These documents should be accepted and approved by the building department prior to issuance of a Certificate of Occupancy.

8. Owner:
   a. Establish allowance for cost of special inspections and tests services.

   b. Provide special inspectors and testing agencies with full access to site at all times.

   c. Sign the Special Inspections and Tests Summary Schedule in conjunction with other responsible parties prior to commencement of construction.

B. Conventional Testing and Inspection

1. Testing Agency:
   a. Test or inspect the work assigned, for conformance with building department approved plans, specifications and applicable workmanship provisions of the IBC.

   b. Bring non-conforming items to the immediate attention of the Contractor, and if uncorrected to the Architect of Record.

   c. Submit test and/or inspection reports to the Architect of Record, the Contractor and other designated persons.

2. Contractor:
   a. Provide adequate notification to testing agency so they may properly prepare for and schedule their work.
b. Provide testing agency with access to the approved design drawings, approved shop
drawings and specifications at the job site.

c. Correct in a timely manner, deficiencies identified in test and/or inspection reports.

d. Provide testing agency with safe access to the work requiring testing and inspection.

e. Provide labor and facilities to provide access to the work and to obtain and handle
samples, to facilitate testing and inspection and for storage and curing of test
samples.

f. Verification of conformance of the work within specified construction tolerances is
solely the Contractor's responsibility.

3. Architect of Record (or other prime consultant):

a. Coordinate the flow of reporting and related information to expedite resolution of
construction issues.

C. Inspections by Building Official

1. Contractor shall provide adequate notice for inspections performed by the Building Official,
as required by the IBC, the Local Building Code, and local ordinance.

D. Periodic Site Observations by Design Consultant

1. Special structural testing and inspection, conventional testing and inspection, and periodic
inspections by the Building Official do not preclude the normal field involvement and site
observations by Architect or Structural Engineer of Record, nor shall it relieve the
Contractor of any responsibility to complete the work in accordance with the approved
drawings and specifications.

E. Limits of Authority

1. Testing agents and/or special inspectors may not waive or alter contract requirements, or
approve or accept any portion of the work unless specifically authorized by the Architect or
Structural Engineer of Record. They may not assume any duties of the Contractor, and
they have no authority to stop or reject "Work".

1.9 PAYMENT

A. Contractor shall directly employ and pay for services of the special inspectors to perform required
Special Inspections and Tests.

B. Owner shall employ and pay for services of the testing agency to perform required Conventional
Testing and Inspection.

C. Unless noted otherwise, the Contractor shall provide and pay for all materials, samples, mock-
ups, and assemblies required for testing and inspection and shall pay for all shipping costs related
to delivery of this work. Testing agency will pay for shipping costs of samples transported from
site to lab.

D. If exploratory work is required to determine the cause of defects, the cost of such work shall be
paid by the Contractor, if the work is found to be defective, in the judgment of the
Architect/Engineer. Contractor shall reimburse the Owner for all costs incurred in this event.

E. Any tests required to qualify the Contractor, or the workmen for any phase of the work, shall be
performed at no additional cost to the Owner.

1.10 INSPECTION NOTICE

A. Contractor shall provide minimum of 24 hours’ notice for all items requiring testing or inspection.
Items requiring testing and inspection services prior to or during placement shall not be placed
until testing and inspection services are available. Items requiring testing and inspection services
after placement shall not be enclosed or obscured until testing and inspection services are performed.

1.11 REPORTS

A. Testing agency and/or special inspectors shall submit reports in accordance with the Structural Testing and Special Inspection Summary Schedule and shall conduct and interpret tests and inspections and state in each report whether; (1) test specimens and observations comply with Contract Documents, and specifically state any deviations, (2) record types and locations of defects found in work, (3) record work required and performed, to correct deficiencies.

B. Reports for structural testing and special inspection, shall be submitted in timely manner to the Contractor, Building Official, SER, and Architect of Record.

1. Submit reports for ongoing work, to provide the information noted below:
   a. Date issued.
   b. Project title and number.
   c. Firm name and address.
   d. Name and signature of tester or inspector.
   e. Date and time of sampling.
   f. Date of test or inspection.
   g. Identification of product and specification section.
   h. Location in project, including elevations, grid location and detail.
   i. Type of test or inspections.
   j. Results of tests or inspections and interpretation of same.
   k. Observations regarding compliance with Contract Documents or deviations there from.

2. Submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved plans, specifications and the applicable workmanship provisions of the code.

C. Reports for conventional testing and inspection shall be submitted in a timely manner to the Contractor and the Architect of Record.

1.12 FREQUENCY OF TESTING AND INSPECTIONS

A. For detailed requirements see technical sections of PART 2.

1.13 PROTECTION AND REPAIR

A. Upon completion of testing, sample-taking, or inspection, the Contractor shall repair damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed surfaces, as judged solely by the Architect/Engineer of Record. Protect work exposed by or for testing and/or inspection and protect repaired work. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for testing and/or inspection.

1.14 TESTS TO DEMONSTRATE QUALIFICATION

A. If the Contractor proposes a product material, method, or other system that has not been pre-qualified, the Architect may require applicable tests, to establish a basis for acceptance or rejection. These tests will be paid for by the Contractor.
B. The Architect/Engineer of Record reserves the right to require certification or other proof that the system proposed, is in compliance with any tests, criteria or standards called for. The certificate shall be signed by a representative of an independent testing agency.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 STATEMENT OF SPECIAL INSPECTIONS

A. Special Inspections and Tests Program Summary: Refer Drawing S001.

B. Statement of Special Inspections Form: Following this Section.
   1. The parties involved shall complete and sign the Statement of Special Inspections Form. The Program, including Summary Schedule, shall be submitted to the building official for approval prior to issuance of a building permit.
   2. The Form includes the following:
      a. A specific listing of the items requiring inspection and testing.
      b. The associated technical scope sections that define the applicable standards by which to judge conformance with the approved plans and specifications in accordance with the IBC. The technical scope sections should also include the degree or basis of inspection and testing; i.e., intermittent/will-call or full-time/continuous.
      c. The frequency of reporting, i.e., weekly, monthly, per test/inspection, per floor, etc.
      d. The parties responsible for performing the inspection and testing work.
      e. The required acknowledgments by each designated party.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the following:
   1. Temporary facilities and controls general requirements.
   2. Facilities and Equipment.
   3. Temporary utility installation
   4. Support facilities installation
   5. Security and protection facilities installation
   6. Moisture and mold control
   7. Operation, termination, and removal
   8. Section requirements
   9. Environmental Protection Regulations.

B. Related Sections:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

1.2 TEMPORARY FACILITIES AND CONTROLS GENERAL REQUIREMENTS

A. Use Charges: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated.

B. Water and Electric Power: Available from Owner's existing system without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations, including, but not limited to:
   1. Erosion Control Plan included in these specifications.
   2. City of Bloomington Erosion Control requirements.

1.4 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities in good operating condition. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.
PART 2 - PRODUCTS

2.1 FACILITIES AND EQUIPMENT

A. Provide field offices, storage and fabrication sheds, and other support facilities as necessary for construction operations. Store combustible materials apart from building.

B. Provide scaffolding as required to accommodate work indicated. Use means and methods and consolidate use of scaffolding wherever possible to facilitate the work and to prevent damage or disruption to adjacent properties.

C. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

D. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference.

C. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
   1. Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Heating and Cooling: Provide temporary heating and cooling required for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Temporary Lighting: Provide temporary lighting with local switching that provides illumination for construction operations, observations, inspections, and traffic conditions as follows:
   1. Indoor Construction Areas: Provide an ambient, uniform distribution of indoor lighting for general illumination as follows:
a. Minimum 5-footcandles (50-lux) in all construction areas during construction.
b. Minimum 10-footcandles (100-lux) for interior working spaces other than gypsum board finishing, paint finishing, and other detailed work.
c. Minimum 20-footcandles (200-lux) for gypsum board finishing, paint finishing, and other detailed work. Provide supplemental task lighting as necessary for detailed work and as requested by Owner or Architect.

2. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.2 SUPPORT FACILITIES INSTALLATION
A. Project identification and other signs shall be in forms, sizes, and in locations approved by Owner.
B. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of [applicable building code].
C. Use of Owner’s existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION
A. Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or that other undesirable effects might result.
B. Furnish and install site enclosure fencing in a manner that will prevent people and animals from easily entering site except by entrance gates.
C. Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
E. Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas from fumes and noise.
F. Install and maintain temporary fire-protection facilities. Comply with NFPA 241.

3.4 MOISTURE AND MOLD CONTROL
A. Before installation of weather barriers, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.
B. After installation of weather barriers but before full enclosure and conditioning of building, protect as follows:
   1. Do not load or install drywall or porous materials into partially enclosed building.
   2. Discard water-damaged and wet material and material that begins to grow mold.
   3. Allow installed wet materials adequate time to dry before being enclosed.
3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for the following:
   1. Construction product general requirements.
   2. Delivery, storage, and handling.
   3. Owner-furnished products.
   4. Substitutions.
   5. Special warranties.
   7. General installation of products.

B. Related Sections:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

1.2 CONSTRUCTION PRODUCTS GENERAL

A. Provide products that comply with the Contract Documents, are undamaged, and are new at the time of installation, unless otherwise noted.

B. Provide products complete with accessories, trim, finishes, and other devices and components needed for a complete installation, intended use, and effect.

1.3 DELIVERY STORAGE AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer’s written instructions for delivery, storage, and handling.

B. Schedule delivery to minimize long-term storage at Project site, and to prevent overcrowding of construction spaces. Deliver products in concert with construction schedule; do not deliver products prematurely.

C. Deliver products to Project site in manufacturer’s original sealed containers and packaging, with labels intact and exposed to view, and with access to manufacturer’s instructions for handling, storing, unpacking, protecting, and installing.

D. Deliver and store materials in planned, designated areas. Inspect products immediately upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged, properly labeled, stored, and protected.

E. Store materials in a visually neat and orderly manner. Arrange materials for proper access and construction operations, with adequate circulation and clean aisles. Put packaging debris in waste containers.

F. Store materials in a manner that will not endanger Project structure, cause damage to adjacent work, or cause hazards or impediments to the public and adjacent property.

G. Store products that are subject to damage by the elements under cover in weathertight enclosures above grade, with ventilation adequate to prevent condensation.
H. Provide off-site storage and protection when site does not permit on-site storage or protection. Verify and arrange bonding requirements and provide bonded storage if required by Owner.

I. Periodically inspect stored products during construction to ensure compliance.

J. Comply with specified additional requirements for delivery, storage, and handling, specified in individual Sections in Divisions 02 – 33.

1.4 SUBSTITUTIONS

A. Product Substitutions: Substitutions include products and methods of construction differing from that required by the Contract Documents and proposed by Contractor after award of the Contract. Substitutions will generally not be considered, with the following exceptions:
   1. Owner-Initiated Substitutions.
   2. Unavailability of a Product.

B. Substitution requests will not be considered under the following conditions:
   1. The substitution request is made in the form of a Request for Interpretation (RFI).
   2. The substitution is indicated or implied on shop drawings or in product data submittals without a substitution request form being submitted.
   3. The substitution request has not been reviewed and approved by Contractor.
   4. Acceptance will require substantial revisions to contract documents or other items of the project, and without reimbursement of costs.
   5. The substitution request does not comply with specified procedures and forms.

C. Provide reimbursement to Owner and Architect for review or redesign services.

D. All substitutions must be accepted by Architect in writing. Substitutions not properly approved and authorized may be considered defective.

E. Substitution Request Form: Submit electronic PDF form copies of each request for consideration. Submit forms via Architect’s web-based information exchange [Program], made available to Contractor free of charge. Use Project-standard form included as Section 016001 – Substitution Request Form, including the following:
   1. Identify product or fabrication or installation method to be replaced.
   2. Include Specification Section number and title and Drawing numbers and titles.
   3. Why specified material or product cannot be provided.
   5. That proposed substitution complies with requirements in the Contract Documents, and that substitute product is recommended by its manufacturer for the application intended.
   6. Identify product to be replaced and provide documentation showing compliance of proposed substitution with applicable requirements. Include a full comparison with the specified product.
   7. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

F. Submit requests within 14-days after signing the Contract. Submit requests in time to permit processing of request and subsequent submittals, if any, sufficiently in advance of when materials are required in the Work.

G. Architect’s Action: If necessary, Architect will request additional information or documentation for evaluation within 1-week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15-days of receipt of request, or 7-days of receipt of additional information or documentation, whichever is later.
1. A Change Order will be the form of acceptance, if substitution affects Contract Time or Sum; or Supplemental Instructions if no change to Contract Time or Sum.

2. Refer to Section 012000 – Contract Document Interpretations and Modifications for procedural requirements.

1.5 SPECIAL WARRANTIES

A. Warranties specified in individual Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer’s disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

C. Manufacturer’s Standard Form: Modified to include Project-specific information and properly executed.

D. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.

E. Refer to Divisions 2 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

F. Submittal: Comply with requirements in Section 017000 – Execution and Closeout Requirements.

1.6 SPECIFYING METHODS AND PRODUCT OPTIONS

A. Specifying Methods: Specification Sections are written according to one or a combination of methods outlined below. Provide Work in concert with methods specified. Comply with submittal, quality assurance, and quality control requirements specified. In case of conflicts or duplications, the Architect will make an interpretation.

1. Descriptive: Section contains detailed, written description of the required properties of a product, material, or piece of equipment and the workmanship required for its installation. Proprietary names of manufacturers are not used.

2. Performance: Section specifies required results, along with criteria for verifying compliance, and without unnecessary limitations on the methods for achieving the required results.

3. Reference Standard: Section incorporates a document established by construction industry consensus that provides rules, guidelines, or characteristics for activities or results, including standards for basic materials, products, design, installation, workmanship, test methods, codes, performance, and life safety.

   a. The provisions of referenced standards are incorporated into the Specifications as though included in their entirety.

4. Proprietary: Section identifies desired products by manufacturer’s names, brand names, model numbers, series, type designation, or other unique characteristics.

B. Product Options: Products are specified in individual Section according to one or a combination of methods outlined below. Contractor’s options for selecting and providing products are limited or expanded according to methods specified.

1. Where no manufacturer or model is indicated, Contractor select and provide products that comply with specified requirements, including salient features, reference standards, performance requirements, functional and other characteristics.
2. **Single Product and Manufacturer:** Provide single manufacturer's specified product, including brand name, model number, series, or type designation.

3. **Single Manufacturer:** Provide products from single-source specified, and as follows:
   a. Where no product is indicated, select and provide products that comply with specified requirements.
   b. Where products are indicated to be selected by Architect, make submittals and provide products selected by Architect.

4. **Acceptable Products:** Provide one of the specified products.

5. **Acceptable Manufacturers:** Provide products from one of the listed manufacturers that complies with specified requirements.

6. **Contractor's Option:** Contractor may provide one of listed products that are of fundamentally different types, and not subject to alternates procedures.

7. **Basis-of-Design:** Where a listed product or manufacturer includes the term "basis-of-design" such product or manufacturer represents the design intent, and has been used in the design and documentation of the described work.
   a. Contractor may provide the basis-of-design product, another product listed, or a product by another manufacturer listed.
   b. Where no other manufacturer or product is listed, comply with requirements for substitutions.
   c. Architect will interpret the design intent.

8. **Comparable Products (Or Equal):** Contractor may submit listed product, or a comparable product by another manufacturer listed that complies with the design intent and specified work results; and not subject to a substitution request.
   a. Architect will interpret the design intent, and may reject products submitted as comparable that do not comply with the design as determined by the Architect.

9. **No Substitutions:** Substitutions will not be considered.

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**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.1 GENERAL INSTALLATION OF PRODUCTS**

A. **Examination:** Examine substrates and conditions for compliance with manufacturer's written requirements including, but not limited to, surfaces that are sound, level, plumb, smooth, clean, and free of deleterious substances; substrates within installation tolerances; and application conditions within environmental limits. Proceed with installation only after unsatisfactory conditions have been corrected.

B. **Preparation:** Prepare substrates and adjoining surfaces according to manufacturer's written instructions, including, but not limited to, filler and primer application.

C. **Comply with manufacturer's written instructions for installation.** Anchor each product securely in place, accurately located and aligned. If applicable, prepare surfaces for field finishing.

D. **Clean exposed surfaces and protect from damage.** During handling and installation, protect construction in progress and adjoining materials already in place.

E. **Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period.** Adjust and lubricate operable components to ensure operability without damaging effects.
SECTION 016001
PRODUCT SUBSTITUTION REQUEST FORM

(Note: Only one substitution per form.)

SUBMITTED TO:

<table>
<thead>
<tr>
<th>TO:</th>
<th>BKV Group Inc.</th>
<th>Substitution Request No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT:</td>
<td>Bloomington Coliseum Elevator Addition</td>
<td>ATTN: Craig Carter</td>
</tr>
<tr>
<td>FROM:</td>
<td></td>
<td>Date:</td>
</tr>
</tbody>
</table>

SPECIFIED ITEM DESCRIPTION:

<table>
<thead>
<tr>
<th>Specification Section:</th>
<th>Material ID:</th>
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<tbody>
<tr>
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<table>
<thead>
<tr>
<th>Section No.:</th>
<th>Article/Paragraph:</th>
</tr>
</thead>
<tbody>
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</table>

PROPOSED SUBSTITUTION: The undersigned requests consideration of the following:

System/Product/Model: 
Installer: 
Additional Comments: 

Savings to owner for accepting substitution: ($ )

Proposed substitution changes contract time: ☐ NO ☐ YES

Reason for not providing specified item: ☐ Owner-initiated ☐ unavailable product ☐ green building program

SUPPORTING DATA:

<table>
<thead>
<tr>
<th>Supporting Data Attached:</th>
<th>Similar Installation(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Drawings</td>
<td>Project:</td>
</tr>
<tr>
<td>☐ Product Data</td>
<td>Location:</td>
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<tr>
<td>☐ Samples</td>
<td>Architect:</td>
</tr>
<tr>
<td>☐ Test Reports</td>
<td>Owner:</td>
</tr>
<tr>
<td>☐ Other Reports</td>
<td>Date Installed:</td>
</tr>
<tr>
<td>☐ Description of changes to the Contract Documents which the proposed substitution will require for its proper installation.</td>
<td></td>
</tr>
</tbody>
</table>

CERTIFICATIONS:

The undersigned certifies that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs, including delivery and delays, caused by the requested substitution.
3. Proposed substitution will have no adverse effect on other trades, construction schedule, or specified warranties.
4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further certifies that the function, appearance, and quality of the proposed substitution are equivalent or superior to the specified item.

SUBMITTED BY:

<table>
<thead>
<tr>
<th>Firm:</th>
<th>ARCHITECT’S REVIEW AND ACTION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>☐ Substitution Approved. Make submittals per Section 013300.</td>
</tr>
<tr>
<td></td>
<td>☐ Substitution Approved as Noted. Make submittals per Section 013300.</td>
</tr>
<tr>
<td>Telephone:</td>
<td>☐ Substitution Approved. Use specified product.</td>
</tr>
<tr>
<td>Signed:</td>
<td>☐ Substitution request received too late. Use specified product.</td>
</tr>
<tr>
<td>Name:</td>
<td>Signed: _____________________</td>
</tr>
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<td>Name: ______________________</td>
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</tbody>
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END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for the following:
   1. Existing conditions, including utilities.
   2. Construction layout and field engineering.
   3. Site maintenance.
   4. Cutting and patching.
   5. Correction of the Work.
   6. Closeout submittals.
   7. Closeout procedures.

B. Related Sections:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the
      Work of all Sections in the Specifications.
   2. Section 017419 - Construction Waste Management.

1.2 EXISTING CONDITIONS

A. Existing Conditions: The existence and location of site improvements, utilities, and other
   construction indicated as existing are not guaranteed. Before beginning work, investigate and
   verify the existence and location of mechanical and electrical systems and other construction
   affecting the Work.
   1. Before construction, verify the location and points of connection of utility services.

B. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for
   clarification of the Contract Documents, submit a request for information to Architect, in
   accordance with Section 012000 – Price and Payment Procedures. Include a detailed
   description of problem encountered, together with recommendations for changing the Contract
   Documents.

1.3 CONSTRUCTION LAYOUT AND FIELD ENGINEERING

A. General: Engage a professional engineer to lay out the Work using accepted surveying
   practices.
   1. Establish benchmarks and control points to set lines and levels at each story of
      construction and elsewhere as needed to locate each element of Project.
   2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain
      required dimensions.
   3. Inform installers of lines and levels to which they must comply.
   4. Check the location, level and plumb, of every major element as the Work progresses.
   5. Notify Architect when deviations from required lines and levels exceed allowable
      tolerances.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck
   measurements before installing each product. Where portions of the Work are indicated to fit to
   other construction, verify dimensions of other construction by field measurements before
fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

1.4 SITE MAINTENANCE

A. General: Maintain a clean and orderly worksite on a consistent basis.

B. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work. Keep circulation zones and areas underfoot clear of waste materials, debris and obstructions.

C. Progress Cleaning: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly.

D. Waste Disposal: Dispose of waste materials lawfully. Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted. Comply with authorities having jurisdiction for removal of hazardous wastes.

1.5 CUTTING AND PATCHING

A. Alterations: Perform cutting and patching integrally with alteration work. Cutting into existing construction as necessary to join new work to existing construction.
   1. Make exploratory cuts into existing surfaces as required to determine what is concealed underneath.
   2. Do not use equipment or methods that change character-defining spaces, or obscure, damage or destroy architectural features. Provide the gentlest means of treatment possible to safely cut and patch existing elements without damage or deleterious effects.

B. Installation of Other Materials: Cut work in place as required to install or attach new elements to or in existing surfaces. Cut existing surfaces to gain access to concealed supports and other services required to complete the work.

C. Finishing: Cut work in place to properly fit various parts indicated to produce total assemblies. Adjust sizes of openings to make new items fit and integrate with finishing process.

D. Tests and Inspections: Perform cutting and patching as necessary to provide samples for testing and inspecting where indicated and as specified. Provide cutting an existing surface as required to allow inspections of partially concealed construction.

E. Do not cut structural members or operational elements without prior written approval of Architect.

F. For patching, provide materials that have installed performance equal or surpassing that of existing materials. For exposed surfaces, provide or finish materials to visually match existing adjacent surfaces to the fullest extent possible.

G. Do not cut structural members or operational elements without prior written approval of Architect.

H. For patching, provide materials whose installed performance will equal or surpass that of existing materials. For exposed surfaces, provide or finish materials to visually match existing adjacent surfaces to the fullest extent possible.
I. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

1.6 CORRECTION OF THE WORK
A. Repair or remove and replace defective new construction. Restore damaged substrates and finishes. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
B. Restore permanent facilities used during construction to their specified condition.
C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

1.7 CLOSEOUT SUBMITTALS
A. General: Make closeout submittals (except written notices) prior to requesting inspection for Substantial Completion.
B. Operation and Maintenance Data: Provide both hard copy and PDF electronic copies of operation and maintenance data. Assemble data into a manual.
   1. Hard Copy: Organize data into three-ring binders with identification on front and spine of each binder and pocket folders for folded sheet information.
   2. PDF: Assemble into a composite file and include active bookmarks.
   3. Submit preliminary copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on acceptability of general scope and content of manual. Make corrections based on Architect's comments.
   4. Submit final manuals prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments. Make corrections based on Architect's comments.
   5. Include the following:
      a. Operation and maintenance documentation directory.
      b. Emergency manuals.
      c. Operation manuals for systems, subsystems, and equipment.
      d. Product maintenance manuals.
      e. Systems and equipment maintenance manuals.
C. Special Warranties: Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual. Provide both hard copy and PDF electronic copies of warranties. Include pertinent project information, including a description of the product or installation, the name of the product, and the name, address, contact information of Installers.
   1. PDF: Assemble into a composite file and include active bookmarks.
   2. Hard Copies: Provide specified warranty documents in a durable 3-ring binder, labeled “WARRANTIES” and the Project name on the cover. Organize using page dividers, according to Specifications table of contents.
D. Certificates of Occupancy: Submit certificates from city building officials and authorities having jurisdiction, showing evidence that required inspections have been completed and the project meets requirements.
E. Keying: Submit keying schedule and keys directly to Owner. For construction keying, remove all construction cylinders, install or rekey the permanent cylinders, and deliver keys to Owner.
   1. Upon request, submit copy of receipt from the Owner verifying that keys have been delivered.

F. Project Record Documents: Maintain record documents at the Project site office, including drawings, specifications, and product data. Mark documents to show installation that varies from the Work originally shown, with erasable, red-colored pencil, and other colors to distinguish markings.
   1. Record Drawings: One set of black-line white prints of Contract Drawings and Shop Drawings. Include the following:
      a. Field changes to dimensions and details.
      b. Modifications to the work, including minor changes and made by Change Order.
      c. Details not on original Contract Drawings.
      d. Underground utilities, noting dimension location of underground utility trenches off of above ground improvements to within 2-feet of actual centerline of trench. Label each utility and locate changes in direction.
      e. Under slab utilities, noting dimension location of pipe and conduit to within 4-inches of centerline of pipe or conduit bank.
      f. Revisions to architectural surface features by revision to plans, sections, and elevations.
      g. Revisions to final grade, slab, and floor elevations.
   2. Record Project Manual: Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications. Include addenda and contract modifications. Note related Change Orders and Record Drawings, where applicable
   3. Record Data: Mark one set to indicate the actual product installation where installation varies substantially from that indicated. Note related change orders and record specifications, where applicable.

G. Written Notice Of Substantial Completion: Contractor’s signed statement that the project is substantially complete and ready for Architect’s inspection for substantial completion, and specified Work is complete prior to substantial completion.

H. Written Notice of Final Completion: Contractor’s signed statement that the project is finally complete and ready for Architect’s final inspection, and specified Work is complete.

1.8 CLOSEOUT PROCEDURES

A. Closeout Meeting: Prior to closeout, schedule and conduct a closeout meeting with the Architect to review closeout procedures and submittal requirements. Coordinate date of meeting with Architect’s periodic site visits and project schedule.

B. Starting of Systems and Equipment: Schedule and coordinate the starting of systems, including mechanical, electrical, fire-protection, sectional overhead doors, and other machine systems with moving and functioning components.
   1. Notify the Architect upon completion that systems are ready for starting.
   2. Determine that interdependent systems are also ready.
   3. Follow system manufacturer’s written startup instructions.
   5. Do not use systems during construction, unless otherwise approved by Owner.
C. Demonstration and Training: Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
   1. Provide experienced instructors for each piece of equipment that requires operation and maintenance to provide instruction to Owner's personnel.
   2. Include instruction for system design and operational philosophy, review of documentation, operations, adjustments, troubleshooting, maintenance, and repair.

D. Final Cleaning: Provide final cleaning when construction operations are complete. Comply with the following:
   1. Remove evidence of construction equipment and debris.
   2. Clean each surface and installed item. Clean exposed finishes to a dust-free condition, free of stains, films, and foreign substances.
   3. Leave concrete floors broom clean.
   4. Vacuum carpeted surfaces and seal resilient flooring.
   5. Remove labels that are not permanent.
   6. Clean glass and mirrors. Remove excess glazing compounds. Replace chipped or broken glass.
   8. Clean the site. Sweep paved areas; remove stains, spills, and foreign deposits. Rake grounds to a smooth, even-textured surface.

E. Substantial Completion: Comply with the following:
   1. Prior to requesting the Architect's inspection for substantial completion inspection, complete the following:
      a. Starting of systems and equipment.
      b. Demonstration of systems and equipment and training.
      c. Submittal of operations and maintenance manuals.
      d. Submit record documents.
      e. Occupancy: Submit occupancy certificates and other evidence of inspections by authorities having jurisdiction. Advise Owner of changeover information related to Owner's occupancy, operation, and maintenance, including insurance.
      f. Submit special warranties, maintenance agreements, and similar documents.
      g. Changeover locks and transmit keys to Owner.
      h. Remove temporary facilities and controls.
      i. Complete final cleaning requirements.
      j. Complete touchup painting. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
   2. Punchlist for Substantial Completion: Submit an initial punchlist of Work items requiring correction or completion by the Contractor, with request for Architect's inspection.
      a. Form: Provide CSI Form 14.1A; or a standard form on Contractor's letterhead, with pertinent project information, date, etc., and corrections itemized with room number, room name or location.
   3. Architect's Inspection: Architect will proceed with inspection or advise Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or advise Contractor of items that must be completed or corrected before the certificate will be issued.
      a. Architect will prepare a supplemental punchlist during Architect's inspection for substantial completion. The 2-punchlists combined will become the final punchlist.
b. Certificate of Substantial Completion: Architect will prepare in triplicate AIA Document G704, sign, and deliver to Contractor, along with final punch list.

F. Final Completion: Request Architect’s inspection for certification of final completion, once the following are complete:
1. Submit Written Notice Of Final Completion.
2. Submit final Application For Payment: Include release of liens and waiver of debts and claims, and consent of surety to final payment, if applicable.
3. Submit special warranties.
4. Copy of final punch list along with Contractor’s statement that each item has been completed or otherwise resolved for acceptance.
5. Architect’s Inspection: Architect will reinspect the Work on receipt of notice that the Work has been completed. On completion of reinspepection, Architect will prepare a final Certificate for Payment. If the Work is incomplete, Architect will advise Contractor of the Work that is incomplete or obligations that have not yet been fulfilled.

G. Final Change Order and Final Payment: Refer to Section 012900 – Contract Payment Procedures.

PART 2 - PRODUCTS

2.1 CUTTING AND PATCHING MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

C. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION (NOT USED)
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Recycling of demolition and new construction waste.
   2. Salvage of removed materials and elements.

B. Related Sections:
   1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
   2. Section 024000 – Demolition.

1.2 SUBMITTALS

A. Waste Management Plan: Develop and submit a waste management plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Include the following:
   1. Submit plan within 30 days of date established for commencement of the Work.
   2. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
   3. Salvaged Materials for Reuse: Identify materials that will be salvaged and reused in the work of this Project.
   4. Salvaged Materials for Sale: Identify materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
   5. Salvaged Materials for Donation: Identify materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
   6. Recycled Materials: Include list of local receivers and processors and types of recycled materials each will accept. Include names, addresses, and telephone numbers.
   7. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan.
   8. Submit updated Waste Management Plan at periodic intervals when plan is updated by new information.

1.3 QUALITY ASSURANCE

A. Maintain Records and Reports as follows:
   1. Waste Reduction Progress: Submit concurrent with each Application for Payment. Include total quantity of waste, total quantity of waste salvaged and recycled, and percentage of total waste salvaged and recycled.
   2. Records of Donations and Sales: Receipts for salvageable waste donated or sold to individuals and organizations. Indicate whether organization is tax exempt.
B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Administrative Requirements."
   1. Review waste management plan, including methods and procedures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

C. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

3.2 SALVAGE OF REMOVED MATERIALS AND ELEMENTS

A. Arrange and place elements and materials to allow access for inventory, evaluation, and selection by Owner and Architect.

B. Elements and materials indicated for salvage include:
   1. Existing building signage.
   2. Ceiling tiles.
   3. Concrete (processed into fill material).
   4. Light fixtures.
   5. Other items as directed.

C. Maintain areas designated for salvaged materials. Store and protect removed, salvaged elements and materials indicated for re-use in new construction.
   1. Protect salvaged material from mishandling, theft, vandalism and fire.
   2. Store and handle salvaged materials indicated for re-use in the same manner as for new materials to the greatest extent possible.

D. Excess Materials: Excess materials that cannot be salvaged for reuse shall be source-separated for recycling. Excess materials that cannot be salvaged or recycled shall be disposed of in accordance with applicable codes at licensed facilities.

E. Preparation for Reinstallation: Reinstallation of salvaged elements and materials shall be performed by trades people skilled in that particular type of work. Clean salvaged items and install salvaged items to comply with installation requirements for new materials and equipment.

F. Salvaged Items for Sale and Donation: Conduct operations legally, and off-site to the greatest extent possible. Maintain sales and donation records.

G. Salvaged Items for Owner's Use (Not Part of New Work): Clean salvaged items and store in a secure area until delivery to Owner. Deliver to Owner as directed.
3.3 RECYCLING WASTE

A. General: Recycle paper and beverage containers used by on-site workers.

B. Construction Material Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

C. Excess Concrete: Process and recycle concrete not indicated to be reused to maximum 1-1/2-inch (38-mm) size; or break up and transport paving to recycling facility at Contractor’s option.
   1. Remove reinforcement and other metals from concrete and sort with other metals.

D. Excess Masonry: Process and recycle masonry not indicated to be re-used to maximum 1-1/2-inch (38-mm) size; or break up walls or make into whole units, and transport to recycling facility at Contractor’s option.
   1. Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

I. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

J. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

K. Conduit: Reduce conduit to straight lengths and store by type and size.

3.4 DISPOSAL OF WASTE

A. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

B. Do not burn waste materials.

END OF SECTION
SECTION 024119
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Selective demolition and modifications of the following existing building elements:
      a. Exterior envelope.
      b. Interior elements and surfaces.
      c. Building utilities and services.
      d. Building equipment.
      e. Site elements.
   2. Salvage removal, including disassembly, of elements and materials indicated for salvage.

B. Coordination: Coordinate the work of this Section with demolition Drawings, and the following:
   1. Section 017419 – Construction Waste Management, for salvage and recycling of removed elements and materials under this Section.
   2. Division 31 Sections for erosion and sedimentation control, re-grading and site preparation related to site demolition activities.
   3. Coordinate demolition operations with utility and building service modifications. Schedule and coordinate tie-ins to existing systems.

C. Definitions: Comply with the following for notations indicated on Drawings:
   1. Demolish: Demolishing includes removal, recycling, or disposal.
      a. Remove materials and items from existing construction, using methods that comply with specified work results.
      b. Recycle materials in accordance with requirements specified in Section 017419 – Construction Waste Management.
      c. Materials and items that cannot be recycled shall be legally dispose of off-site.
   2. Salvage / Salvage Removal: Salvaging includes materials and elements indicated for reuse or reinstallation in new work, and for salvage by Owner for their storage or future work. Salvaged items may include items indicated to be cleaned and prepared, and materials processed on site.
      a. Carefully detach items from existing construction and deliver them to designated areas for storage, cleaning, and preparation for reuse in new construction. Requirements for salvaged products used in new construction are specified in other applicable sections.
   3. Disassemble: Dismantle assemblies indicated into basic components, using means and methods that maintain components substantially intact, without material damage or deformation.
      a. Do not cut materials that can be disassembled by mechanical means, unless otherwise approved by Architect or Owner.
   4. Existing: Drawings may indicated existing items and materials to remain for clarity or to distinguish from new items.
a. Take measures to protect existing items of construction that are not to be demolished or salvaged from damage resulting from demolition and new construction activities, through substantial completion.

D. Unforeseen Conditions: Where unanticipated work is encountered or uncovered during demolition operations that is not documented, nor reasonably inferable as part of the work, notify Architect immediately.
   1. Refer to unit price schedule submittal and comply with Section 012000 – Price and Payment Procedures, for general procedural and administrative requirements.

E. General Performance Requirements: Make modifications to existing building structure, exterior envelope, interiors, services, equipment, and site elements as required to accommodate new work. Comply with the following:
   1. Coordinate work of salvage with Demolition Drawings, and as follows:
      a. Survey existing conditions and correlate with requirements indicated to determine extent of salvage and demolition required.
      b. Keep complete documentation of all salvaged materials including the condition of such materials before and after salvage operations.
   2. Develop a written demolition plan detailing procedures, coordination with other work, sequences, demolition methods, protection, and special requirements.
   3. Schedule and sequence demolition activities, methods, and techniques in a manner that leaves work ready for successive work, accommodates new work indicated, and prevents damage to remaining portions of the building.
   4. Perform preparatory work as required to maintain site conditions, accommodate demolition activities, and successive construction.
   5. Specialized Demolition Work: Use specialized methods and equipment appropriate to the type of work and materials indicated and to produce specified work results in this Section.
      a. Engage the services of specialists as required to complete the work.
   6. Comply with requirements of regulatory authorities having jurisdiction that govern demolition work applicable to this Project.
   7. Take measures to ensure safety on site and protection of adjacent structures and property.
   8. Leave exposed portions of existing work affected by demolition activities ready for further preparation and treatment to accept new products indicated.

1.2 SUBMITTALS

A. Demolition Plan: Prior to pre-demolition walk-through, submit a written plan describing Contractor’s approach to performing demolition work, including procedures, coordination with other work, operational sequences, demolition methods, protection, and special requirements. Include the following:
   1. Schedule of demolition activities, methods and techniques, including special applications.
   2. Preparatory work description, including coordination with Owner’s hazardous materials abatement, site access and security, temporary facilities, and structural shoring.
      a. Include building decontamination measures for non-hazardous waste conditions that are not identified as part of Owner’s hazardous materials abatement.
   3. Protection during demolition, including control of dust, noise, and vibration; fire protection, protection of adjacent structures and property, and stormwater and erosion control measures.
   4. Demolition methods including cutting methods and equipment related to materials and elements to be modified.
   5. Coordination of substrate preparation materials methods.
6. Indicate discrepancies between field conditions and Drawings, and proposed remedies to accommodate new work indicated.

B. Documentation of Existing Conditions:
   1. Prior to commencement of demolition and salvage removal, submit photographs of existing damage on surfaces, equipment, and adjacent improvement that might be misconstrued as damage related to demolition and salvage operations.
   2. Submit a graphic and photographic record of existing conditions at all locations where removal, salvage and reinstallation of existing materials and items are indicated, including where removal is required for construction or restoration work.

1.3 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
   1. Specialty Demolition Work: Where demolition work is indicated or involved special methods and techniques, engage specialists qualified in the area of work indicated.

B. Regulatory Requirements: Comply with applicable codes, ordinances, rules, and regulations, including those for demolition, transportation, and disposal of debris
   1. Comply with governing EPA notification regulations
   2. Comply with City and State applicable codes for demolition work, safety of structure, and dust control.
   3. Obtain required permits from authorities.
   4. Notify affected utility companies prior to starting work; comply with utility company requirements.
   5. Conform to applicable codes when hazardous or contaminated materials are discovered.
   6. Do not close or obstruct exits or access routes.
   7. Arrange for, obtain permits and certificates for, and pay fees required, including
      a. Transportation and disposal of debris.
      b. Demolition operations.
      c. Utility severance or relocation, including removing meters and capping lines.
      d. Use or closing of streets, sidewalks, or other public places.

C. Comply with NFPA 241. Take measures to safeguard demolition and alteration operations, including temporary construction, equipment and storage, electrical utilities, and fire-protection.
   2. Do not allow accumulations of combustible waste material, dust, or debris; remove from structure and vicinity as necessary for safe operations.
   3. Maintain access routes required by authorities having jurisdiction.

D. Design shoring, bracing, underpinning and reinforcement under direct supervision of a Structural Engineer experienced in design of this Work and licensed in the Project State.

E. Hazardous Materials: Comply with Contract General Conditions.

F. Pre-Demolition Walk-Through and Conference: Conduct on-site walk-through and pre-demolition conference at Project site. Comply with requirements in Section 013000 – Administrative Requirements, and the following:
   1. Attendees: Owner, Architect, Contractor, demolition contractor, and other relevant project participants.
   2. Agenda: Include the following:
a. Review Contractor’s demolition plan. Make modifications and refinements to the submitted plan
b. Owner will indicated items for salvage.
c. Options.
d. Possible conflicts.
e. Acceptability of substrates.
f. Temporary facilities and controls.
g. Space and access limitations.
h. Regulations of authorities having jurisdiction.
i. Coordination with other work.
j. Required performance results.
k. Protection of adjacent work.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions. Distribute minutes.
4. Do not proceed with demolition until conference can be successfully concluded.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Erect temporary partitions, barricades, warning devices, and controls.

B. Provide protective coverings, shoring, bracing, and supports for construction designated to remain.

C. Temporarily or permanently disconnect utilities as required.

D. Prior to beginning demolition, verify the following:
   1. Structures are unoccupied and removed from service.
   2. Temporary controls and devices are in place and operational.
   3. Utilities are temporarily or permanently disconnected or relocated as required.
   4. Items salvaged for Owner are removed and stored in designated area.

3.2 SALVAGE REMOVAL

A. General: Refer to keynotes on Demolition series Drawings; and comply with requirements in Section 017419 – Construction Waste Management, for salvage of existing elements and materials.

B. Where elements are indicated to be salvaged, document materials and elements in their existing position and condition.

C. Remove architectural elements by carefully detaching from substrates in a manner that prevents damage to items and existing surfaces.

D. Remove materials indicated for salvage and reuse in site work and landscaping using processing equipment suitable for types of materials indicated, and as required to produce specified work results.
E. Applicable materials and elements indicated to be salvaged shall be carefully crated and packed to prevent damage during transportation and storage. Items damaged during removal and storage shall be repaired or replaced to match existing items.

F. Deliver salvaged items to areas designated for storage, evaluation, selection, cleaning, or other successive work prior indicated.

G. Where disassembly is indicated, dismantle assemblies indicated using means and methods that maintain components substantially intact, without material damage, destruction, or deformation.
   1. Do not cut materials that can be disassembled by mechanical means, unless otherwise approved by Architect or Owner.

3.3 DEMOLITION

A. General: Remove existing construction to extent indicated and as necessary to join new work to existing. Do not remove more than is indicated or as necessary to allow for new construction.
   1. Demolish structures in accordance with demolition procedures approved by Architect.
   2. Do not damage work designated to remain. Use precision methods and equipment to perform demolition. Leave surfaces and substrates ready for further preparation and installation of new and salvaged products and materials.
   3. Minimize noise and spread of dirt and dust.
   4. Assign work to trades skilled in procedures involved.
   5. Protect and support active utilities designated to remain. Post warning signs showing location and type of utility and type of hazard.
   6. Store items designated to remain property of Owner where directed by Owner.
   7. Remove and dispose of waste materials off site.
   8. Sprinkle debris, and use temporary closures as necessary to limit dust to lowest practical level.

B. Concrete: Employ methods as required to achieve clean, straight edges, and to accommodate new Work. Use precision sawing and drilling equipment, such as diamond- and carbide-tipped saws and drills. Employ methods that prevent over-cutting of corners, such as stitch-drilling or hand sawing methods.
   1. Where indicated, process concrete waste mulch for materials indicated and as directed. Stockpile materials in designated areas for reuse in new construction.
   2. Mark ends of exposed, cut reinforcing bars with flag tape and paint with visible color zinc-rich paint.

C. Utilities: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

D. Site Elements:
   1. Remove walks, paving, curbs, gutters, and site improvements.
   2. Uniformly grade areas to smooth surface. Adjust contours to eliminate water ponding and provide positive drainage. Make grade changes gradually. Blend slopes into level areas.

3.4 MATERIAL DISPOSAL

A. Disposal:
   1. Materials, equipment, and debris resulting from demolition operations becomes property of Contractor. Remove debris as soon as practical.
   2. Cover debris in trucks to prevent spillage during transportation.
   3. Do not store or burn materials on site.
4. Transport debris not salvage nor recyclable and legally dispose of at an off-site disposal facility.

3.5 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION
SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY
A. This Section specifies cast-in-place concrete, including, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. 
   5. Miscellaneous Items.
B. Related Sections:
   1. Division 01 Section "Special Inspections and Tests" for independent testing agency procedures and administrative requirements.
   2. Division 03 Section "Architectural Precast Concrete".
   3. Division 05 Section "Structural Steel" for anchor bolts, embedded plates and angles.
   4. Division 31 Section "Earth Moving" for fill under slabs-on-grade.
   5. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.2 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.
B. ITL: Independent testing laboratory approved by architect and paid by owner.

1.3 SUBMITTALS
A. Product Data, Reinforcing:
   1. Submit mechanical splice manufacturer’s literature indicating splice type and catalog number.
   2. Include manufacturer’s published recommendations for installation.
B. Steel Reinforcement Shop Drawings:
   1. Placing drawings that detail fabrication, bending, and placement for concrete and masonry work. Include bar sizes, lengths, material, and grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   2. For masonry work, include wall elevations showing placement of reinforcing, splice length, location and cover.
C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Proportion in accordance with ACI 318 Section 5.3, Proportioning on the Basis of Field Experience and/or Trial Mixtures.
a. If trial batches are used, submit mix designs prepared by the ITL that achieve 28 day compressive strengths 25% higher than specified strengths.

b. If historical data is used, accompany mix designs with complete standard deviation analysis.

2. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

1.4 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.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA’s "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade I, according to ACI CP-01 or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer’s plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specification for Structural Concrete."
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
   3. ACI 315, "Details and Detailing of Concrete Reinforcement."
   4. ACI 301, Section 5.4, tolerances.

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Deliver site applied materials, such as joint sealers, curing materials, in original factory packaging and unopened containers and protect from damage and contamination.
1.6 FIELD CONDITIONS

A. 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 (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
   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.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:
   1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Rough-Formed Finished Concrete: As defined by ACI 301 Article 2.2.1. Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

B. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

A. Epoxy-Coated Reinforcing Bars: ASTM A 775 or ASTM A 934, with less than 2 percent damaged coating in each 12-inch bar length.

B. Deformed-Steel Wire: ASTM A 496.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Smooth Bar Dowel Coating: Grease or bituminous coating.

C. Smooth Bar Dowel Support Baskets:
   1. Manufacturer: American Highway Technology

D. Smooth Plate Panels & Baskets:
   1. Manufacturer: PNA, INC.

E. 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.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
      a. Fly Ash: ASTM C 618, Class C.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Maximum Coarse-Aggregate Size:
      a. Provide largest aggregate size that meets following criteria:
         1) 1/5 of narrowest dimension between sides of forms
         2) 1/3 of depth of slabs
         3) 3/4 of minimum clear distance between reinforcing bars or between bars and forms, whichever is least.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

E. Water: ASTM C 94 and potable.
   1. Adjust proportions based on review and approval of sample panels

2.5 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494, Type A.
   2. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

C. Prohibited Admixtures: Admixtures containing more than 0.05 percent chloride ions.

D. Crystalline Waterproofing Additive:
   1. Kryton; Krystol Internal Membrane (Basis of design)
   2. Xypex Chemical Corporation - Comparable product
   3. Acceptable Substitute

2.6 FIBER REINFORCEMENT

A. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.7 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
   1. Products:
      a. Kryton; Krytonite Swelling Waterstop
      b. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
      c. Progress Unlimited, Inc.; Superstop.
      d. TCMiraDRI; Mirastop.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
   1. Products:
      a. Burke by Edoco; Aqua Resin Cure.
      b. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
F. **SC-1**: Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
   1. Products:
      a. Burke by Edoco; Cureseal 1315 WB.
      b. Euclid Chemical Company (The); Super Diamond Clear VOX.
      e. Tamms Industries, Inc.; LusterSeal WB 300.

2.9 **JOINT MATERIALS**

A. Joint Backer:
   1. Manufacturers:
      b. Sonneborn, Sonofoam
      c. Other pre-approved product.
   2. Closed cell foam backer rod.

B. Joint Sealer
   1. Mameco, Vulkem 45.
   2. W. R. Meadows
   3. Other pre-approved product.


D. Interior Bond Breaker Joint: 30 pound asphalt felt, unperforated.

2.10 **RELATED MATERIALS**

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.11 **FABRICATING REINFORCEMENT**

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 **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:**
   1. **Fly Ash:** 25 percent.
   2. **Combined Fly Ash and Pozzolan:** 25 percent.
   3. **Ground Granulated Blast-Furnace Slag:** 50 percent.
   4. **Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag:** 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
   5. **Silica Fume:** 10 percent.
   6. **Combined Fly Ash, Pozzolans, and Silica Fume:** 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
   7. **Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume:** 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

### 2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. **Footings:** Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   3. Slump Limit: 4-inches, plus or minus 1-inch.

B. **Foundation Walls:** Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 4-inches, plus or minus 1-inch.

C. **Slabs-on-Grade, Interior:** Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   3. Slump Limit: 4-inches, plus or minus 1-inch.
   4. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
   5. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

D. **Miscellaneous Items:** Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 3000 psi at 28 days.
   3. Slump Limit: 4 inches, plus or minus 1 inch.

### 2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

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. Do not construe tolerances for horizontal or vertical building line or footings to permit encroachment beyond legal boundaries.

C. Compensation:
   1. Where necessary to maintain specified tolerances, camber formwork to compensate for anticipated deflection in formwork due to weight and pressure of fresh concrete and due to construction loads.
   2. Construct forms for exposed concrete to allow for deflection and to eliminate bulges, offsets or other unsightly features in finished surfaces.
   3. Provide positive means of adjustment, such as wedges or jacks, for shores and struts and take up settlement during concrete placing operations.

D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
   2. Class B, 1/4 inch for rough-formed finished surfaces.
   3. Class C, 1/2 inch for rough-formed finished surfaces.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. 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.

G. 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.

H. 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.

I. Chamfer all exterior corners and edges of permanently exposed concrete.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Protect forms for deterioration, weather, and shrinkage prior to concreting by oiling or wetting.

L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

N. 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 INSTALLATION OF VOID FORMS AND SOIL RETAINERS
A. Placement:
   1. Place forms on smooth, level, firm, dry surface.
   2. Butt carton forms tightly end to end and side to side, seam side down.
   3. Place cover sheets on carton forms and staple.
B. Moisture Protection:
   1. Do not let carton forms become wet.
   2. Remove and replace wet cartons.
C. Place soil retainers at edge of grade beams.

3.4 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 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
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.
D. Adjustments to Removal Time:
   1. Minimum elapsed time for form removal of supported elements may be reduced when accompanied by testing program developed by Contractor and approved by ITL and Architect.
   2. If high-early-strength concrete or retarding agents are used, adjust minimum periods upon approval by ITL and Architect.

3.5 STEEL REINFORCEMENT INSTALLATION
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.
   2. Adjust reinforcing to avoid sleeves, blockouts and other voids in 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.

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. Where concrete surface is exposed to weather or where rust would impair Architectural finishes, use galvanized or plastic accessories.

G. Cover: Locate reinforcing to provide minimum concrete thickness according to ACI 318, unless noted otherwise on Drawings.

3.6 EPOXY-COATED REINFORCEMENT INSTALLATION

A. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.7 WELDED WIRE FABRIC INSTALLATION

A. Splice fabric so that overlap between outermost cross wires of each fabric sheet is minimum two wire spaces.

B. Support fabric off grade or floor deck before placing concrete and wire together to prevent displacement of fabric during concrete placement.

C. In structural concrete slabs over floor deck, locate fabric at center of slab depth, form top of slab to top of deck, unless noted otherwise on Drawings.

3.8 SMOOTH BARS DOWELS INSTALLATION

A. Center dowels on joints, position dowels at center of slab depth and align perpendicular to face of joints both vertically and horizontally.

B. Within 30 minutes before placement of adjacent concrete along doweled joints, apply dowel coating on free ends of dowels.

3.9 FIBER REINFORCEMENT INSTALLATION

A. Install fiber reinforcement in concrete topping and slabs on grade.

B. Use and proportion in accordance with manufacturer’s published recommendations.

3.10 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls no more than 60 feet on center. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

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 Division 7 Section "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.

3.11 WATERSTOPS
A. Self-Expanding Strip and Embedded Waterstops: Install in construction joints and at other locations indicated, according to manufacturer’s written instructions and firmly into place. Install in longest lengths practicable.

3.12 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.

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.
3. Before concrete slabs on grade are placed, verify that granular base is level and compacted.
4. Sprinkle base to eliminate suction of water from concrete.
5. Allow no freestanding water.
6. Screed slab surfaces with a straightedge and strike off to correct elevations.
7. Slope surfaces uniformly to drains where required.
8. 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. Deposit and consolidate concrete toppings in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Prior to placing topping, remove laitance and loose particles of sand and dirt.
   2. Remove oil and grease spots by washing with 10 percent solution of muriatic acid or strong washing soda.
   3. After cleaning, hose down with pressure hose and keep base slab wet for at least 12 hours.
   4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

G. 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.

H. 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.

3.13 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.
B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.14 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces to receive trowel finish.

3.15 CONCRETE SLAB INSTALLATION TOLERANCES

A. Conform to ACI 347 except for floor slab tolerances.

B. Floor slab tolerances provided for localized areas apply to sections maximum one bay in length and minimum one-half bay.

C. Typical Interior Slab on Grade Tolerances:
   1. Overall slab area: Ff 30/ Fl 25.
   2. Localized minimum: Ff 20/ Fl 15.

3.16 MEASUREMENT OF FLOOR TOLERANCES

A. Frequency: Provide one of the following:
   1. Conduct floor tolerance or measurements for each day's slab placement.
   2. Conduct floor tolerance or measurements only if slab appears to be out of tolerance.

B. Conduct measurement of floor tolerance for Ff 100/ Fl 75 areas by floor consultant utilizing Face Floor Profileograph, or other system approved by Architect.

C. Conduct measurement of floor tolerance for other slab areas utilizing Dip Stick Profiler.

3.17 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. 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. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
C. Embedded items: Install reinforcing, anchors, embedded plates, embedded angles and anchors bolts for items shown on Drawings.

D. Sleeves: Install sleeves for pipe and conduit.

3.18 **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. **Curing Compound:** Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
   4. **Curing and Sealing Compound:** Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial
application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.19 JOINT SEALING
A. Prepare, clean, and install joint sealer according to manufacturer's written instructions.
1. Defer joint sealing until concrete has aged at least six months. Do not seal 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 joint sealer over joint backer.

3.20 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 six months. 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 semi-rigid 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.

3.21 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 in solid concrete, but not less than 1 inch in depth. 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. 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.

5. 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.

3.22 FIELD QUALITY CONTROL

A. Special Inspections: Engage a special inspector to perform field tests and inspections and prepare test reports.
   1. Refer to Section 014100 and Drawing S100 for structural testing and special inspection requirements.

B. Inspections:
   1. Steel reinforcement placement.
   2. Steel reinforcement welding.
   3. Anchor bolts, embedded plates and angles.
   4. Headed bolts and studs.
   5. Verification of use of required design mixture.
   6. Concrete placement, including conveying and depositing.
   7. Curing procedures and maintenance of curing temperature.
   8. 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. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143; 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.

4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg. F and below and when 80 deg. F and above, and one test for each composite sample.

6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure one set of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

10. 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.

11. 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.

12. 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.

13. 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 or by other methods as directed by Architect.

14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION
SECTION 034500
ARCHITECTURAL PRECAST CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulated, load-bearing, architectural precast concrete units.

B. Related Sections:
   1. Section 033000 – Cast-in-Place Concrete, for structural concrete.
   2. Section 079200 – Joint Sealants.

1.2 REFERENCES

A. American Concrete Institute (ACI) 301 - Specifications for Structural Concrete for Buildings.

B. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

C. American Welding Society (AWS):
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.4 - Structural Welding Code - Reinforcing Steel.

D. ASTM International (ASTM):
   5. A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
E. Precast/Prestressed Concrete Institute (PCI):
   1. MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
   2. MNL-120 - Design Handbook - Precast and Prestressed Concrete.
   3. MNL-122 - Architectural Precast Concrete.

1.3 SUBMITTALS

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

B. Design Mixes: For each concrete mix.

C. Shop Drawings: Detail fabrication and installation of precast architectural concrete units. Indicate member locations, plans, elevations, dimensions, shapes, cross sections, limits of each finish, and types of reinforcement, including special reinforcement.
   1. Indicate separate face and backup mix locations and thicknesses.
   2. Indicate locations and extent and treatment of dry joints if two-stage casting is proposed.
   3. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.
   4. Indicate locations and details of anchorage devices to be embedded in other construction.
   5. Indicate provisions for drainage, including base flashing.

D. Design Reference Sample: Samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).
   1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

E. Delegated-Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Show governing panel types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

F. Informational Submittals:
   1. Qualification Data: For Installer and Fabricator.
   2. Welding certificates.
   3. Material Certificates: For the following items:
      a. Cementitious materials.
      b. Reinforcing materials and prestressing tendons.
      c. Admixtures.
      d. Bearing pads.
      e. Structural-steel shapes and hollow structural sections.
      f. Insulation.
4. Material Test Reports: For the following:
   a. Aggregates.
5. Field quality-control and special inspection reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed precast architectural concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast architectural concrete units similar to those indicated for this Project and with a record of successful in-service performance.
   1. Fabricator is a PCI Certified Plant, A1 – Architectural Precast.
   2. Assumes responsibility for engineering precast architectural concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

C. Delegated-Design Professional Engineer: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.


E. Calculated Fire-Test-Response Characteristics: Where indicated, provide precast architectural concrete units whose fire resistance has been calculated according to PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," or ACI 216.1/TMS 0216.1, "Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies," and is acceptable to authorities having jurisdiction.

F. Fabricator’s Sample Panel for Approval: Before fabricating precast architectural concrete units, produce sample panels to establish the approved range of selections made under sample Submittals. Produce a minimum of 3 sets of full-scale sample panels, approximately 1200 mm (48 inches) long by 1200 mm (48 inches) high, to demonstrate the expected range of finish, color, and texture variations.
   1. Architect’s Sample Panel: Architect will provide an established sample panel to Contractor as a basis for panel matching. Match Architect’s sample panel.
   2. Locate panels where indicated or, if not indicated, as directed by Architect.
   3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of surface blemishes to match adjacent undamaged surfaces.
   4. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
   5. Demolish and remove sample panels when directed.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Administrative Requirements."
1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver precast architectural concrete units to Project site in such quantities and at such times to ensure continuity of installation. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so markings are visible.
B. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.

1.6 SEQUENCING
A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Delegated Design: Engage a qualified professional engineer, as defined in Quality Assurance Article, to design architectural precast concrete, using performance requirements and design criteria indicated.
B. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
C. Calculated Fire-Test-Response Characteristics: Provide architectural precast concrete units with fire-resistance rating indicated as calculated according to ACI 216.1 (ACI 216.1M), PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and acceptable to authorities having jurisdiction.
D. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
   2. Construction Load: Design panels as required to accommodate loads related to fabrication, transportation, installation, and other loads related to construction.
E. Design precast concrete units and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
   1. Upward and downward movement of [3/4 inch (19 mm)].
F. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F (67 deg C).
G. Fire-Resistance Rating: Select material and minimum thicknesses to provide 1-hour fire rating.
H. System Drainage: 2 stage joints.
I. Joint Design: Provide precast architectural concrete wall panels that incorporate 2-stage, pressure-equalizing joints.
J. Joint Sizing: Determine joint sizes in accordance with ASTM C1472.
K. Thermal Performance: Product panels with the following thermal resistance properties:
   1. R-Value: R11.4.
2.2 ARCHITECTURAL PRECAST CONCRETE

A. Architectural Insulated Precast Concrete Panels: Prefabricated, pre-stressed sandwich wall panels composed of two connected concrete wythes separated by a layer of insulation, providing multiple functions of resisting imposed loads and insulating the structure.

1. Type of Panel: Non-composite as shown on Drawings.
2. Acceptable Fabricators: Fabricators complying with qualifications under Quality Assurance article in this Section and as follows:
   a. ATMI
   b. Dukane
   c. Mid States
   d. Other pre-approved fabricator.

B. Mold Materials:

1. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes.
2. Form Liners: Units of face design, texture, arrangement, and configuration indicated.
3. Surface Retarder for Exposed-Aggregate Finish: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

C. Reinforcing Materials: One or a combination of the following:

1. Reinforcing Bars: ASTM A 615/A 615M, Grade 420 (Grade 60), deformed.
3. Deformed-Steel Wire: ASTM A 496.
5. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to CRSI's "Manual of Standard Practice," PCI MNL 117, and as follows:
   a. For uncoated reinforcement, use CRSI Class 1 plastic-protected, or CRSI Class 2 stainless-steel bar supports.

D. Prestressing Tendons:

1. Prestressing Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), uncoated, seven-wire, low-relaxation strand.
   a. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.

E. Concrete Materials:

1. Portland Cement: ASTM C 150, Type I or Type III, of same type, brand, and source.
   a. Provide blend of 50 percent white concrete and 50 percent gray concrete for exposed exterior concrete mix.
   b. Standard gray portland cement may be used for nonexposed backup concrete.
2. Supplementary Cementitious Materials:
a. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
b. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
c. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

3. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with weather exposure Classification.
   a. Face-Mix Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining.
      1) Gradation: Match design reference sample.
   b. Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by Architect.

4. Concrete Color Admixture: Product complying with ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading, alkali resistant; and of type required to match Architect’s sample selection.

5. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

6. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

7. Chemical Admixtures: Do not use chemical admixtures, unless approved by Architect and required to suit Project conditions.
   a. If admixtures are required, provide products certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture; and as follows:
      1) Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
      2) Retarding Admixture: ASTM C 494/C 494M, Type B.
      3) Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
      4) Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
      5) High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
      6) High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
      7) Plasticizing Admixture: ASTM C 1017/C 1017M, Type I.
      8) Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
      9) Corrosion Inhibiting Admixture: ASTM C 1582/C 1582M.

F. Steel Connection Materials:
   1. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M
   2. Carbon-Steel Headed Studs: ASTM A 108, Grades 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with the minimum mechanical properties of PCI MNL 116, Table 3.2.3.
   3. Carbon-Steel Plate: ASTM A 283/A 283M, Grade C.
   4. Malleable Iron Castings: ASTM A 47/A 47M. Grade 32510 or 35028.
   5. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).
   6. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M
   7. Carbon-Steel Structural Tubing: ASTM A 500/A 500M, Grade B or C.
   8. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65 (Grade 450).
9. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
11. Zinc-Coated Finish: For steel items in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M, after fabrication, ASTM A 153/A 153M, or ASTM F 2329 as applicable.
   a. For steel shapes, plates, to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon content and 2.5 times phosphorous content to 0.09 percent.
   b. Galvanizing Repair Paint: Zinc paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
12. Shop-Primed Finish: For steel items completely within the exterior building envelope, prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79; or SSPC-Paint 25 according to SSPC-PA 1.

G. Stainless-Steel Connection Materials:
   1. Stainless-Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201.
   2. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy Group 1 or 2 (ASTM F 738M, Grade A1 or A4) hex-head bolts and studs; ASTM F 594, Alloy Group 1 or 2 (ASTM F 836M, Grade A1 or A4) stainless-steel nuts; and flat, stainless-steel washers.
      a. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
   3. Stainless-Steel-Headed Studs: ASTM A 276, Alloy 304 or Alloy 316, with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

H. Bearing Pads: Provide one of the following types of bearing pads for precast architectural concrete units:
   1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi (15.5 MPa), ASTM D 412.
   2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi (20.7 MPa) with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
   3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
   4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.

I. Accessories:
   1. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.
2. Formed Base Flashing: Stainless-Steel Sheet complying with ASTM A 240/A 240M, Type 304; No. 2D (dull, cold rolled) finish.

J. Insulated Panel Accessories:
1. Extruded-Polystyrene (XPS) Board Insulation: ASTM C 578, Type IV, 1.55 lb/cu. ft. (25 kg/cu. m).
   b. Thickness: As detailed on Drawings.
   c. R-value: [specify] per inch.
2. Noncomposite Wythe Connectors: Glass-fiber and vinyl-ester polymer connectors, polypropylene pin connectors, or stainless-steel pin connectors manufactured to connect wythes of precast concrete panels without shear transfer.

K. Grout Materials:
1. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application.
2. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.
3. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.3 CONCRETE MIXES
A. Prepare design mixes for each type of concrete required. Limit use of fly ash and silica fume to not exceed, in aggregate, 25 percent of portland cement by weight.
B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast architectural concrete fabricator's option.
C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318M (ACI 318).
D. Normal-Weight Concrete Face and Backup Mixes: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): Refer to Structural Drawings.
E. Water Absorption: 12 to 14 percent by volume, tested according to PCI MNL 117.
F. Lightweight Concrete Backup Mixes: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
   1. Compressive Strength (28 Days): 34.5 MPa (5000 psi).
   2. Unit Weight: Calculated equilibrium unit weight of 1842 kg/cu. m (115 lb/cu. ft.), plus or minus 48 kg/cu. m (3 lb/cu. ft.), according to ASTM C 567.
G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

H. When included in design mixes, add other admixtures to concrete mixes according to manufacturer's written instructions.

2.4 FABRICATION

A. Mold Fabrication: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing operations.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concreting. Coat form liner with form-release agent.

2. Maintain molds to provide completed precast architectural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
   a. Edge and Corner Treatment: Chamfers.

B. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

C. Furnish loose steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast architectural concrete units to supporting and adjacent construction.

D. Cast-in reglets, slots, holes, and other accessories in precast architectural concrete units to receive windows, cramps, dowels, reglets, waterstops, flashings, and other similar work as indicated. Cast-in finish features with molds where indicated.


1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.

2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.

3. Place reinforcement to maintain at least 19-mm (3/4-inch) minimum coverage. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce precast architectural concrete units to resist loads indicated, including handling, transportation, and erection stresses.

G. Mix concrete according to PCI MNL 117 and requirements in this Section. After concrete batching, no additional water may be added.

H. Place face mix to a minimum thickness after consolidation of the greater of 25 mm (1 inch) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover.
I. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 117 for measuring, mixing, transporting, and placing concrete.

1. Place backup concrete to ensure bond with face mix concrete.

J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 117.

K. Comply with ACI 305R recommendations for hot-weather concrete placement.

L. Identify pickup points of precast architectural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast architectural concrete unit on a surface that will not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

N. Discard precast architectural concrete units that are warped, cracked, broken, spalled, stained, or otherwise defective unless repairs are approved by Architect.

O. Insulated Panel Casting:
   1. Cast and screed supported wythe over mold.
   2. Immediately place insulation boards, abutting edges and ends of adjacent boards. Stagger end joints between rows. Stagger joints of insulation layers one-half board apart. Insert wythe connectors through predrilled insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
   3. Cast and screed structural wythe and apply initial float finish.

P. Fabrication Tolerances:
   1. Fabricate precast architectural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

Q. Exterior Face Finish: Match existing wall panels.


S. Finish exposed top bottom and back surfaces of precast architectural concrete units by smooth, steel-trowel finish.

T. Finish unexposed surfaces of precast architectural concrete units by float finish.

2.5 SOURCE QUALITY CONTROL

A. Architectural Precast Concrete Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C 1610/C 1610M, ASTM C 1611/C 1611M, ASTM C 1621/C 1621M, and ASTM C 1712.

1. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
2. **Defective Units:** Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range.
   a. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval.
   b. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups.
   c. Replace unacceptable units with precast concrete units that comply with requirements.

**PART 3 - EXECUTION**

3.1 **EXAMINATION**

A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Do not install precast concrete units until supporting concrete has attained minimum design compressive strength.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **INSTALLATION**

A. Install clips, hangers, and other accessories required for connecting precast architectural concrete units to supporting members and backup materials.

B. Install formed base flashing where required to drain 2-stage joints.

C. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.
   1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
   2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
   3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
   4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).

D. Install precast architectural concrete. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
   1. Install bearing pads as precast concrete units are being erected.
   2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
   3. Remove projecting hoisting devices and use sand-cement grout to fill voids within recessed hoisting devices flush with surface of concrete.

E. Anchor precast architectural concrete units in position by bolting, welding, grouting, or as otherwise indicated. Remove temporary shims, wedges, and spacers as soon as possible after anchoring and grouting are completed.
F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil- (0.1-mm-) thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780/A 780M.
5. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

G. At bolted connections, use lock washers or other acceptable means to prevent loosening of nuts.

H. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
   d. Direct-Tension Control Bolt: ASTM F 1852.
3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.

I. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.


3.3 ERECTION TOLERANCES

A. Install precast architectural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

B. Install precast architectural concrete units level, plumb, square, and true, without exceeding the following noncumulative erection tolerances.

1. Plan Location from Building Grid Datum: Plus or minus 13 mm (1/2 inch).
2. Plan Location from Centerline of Steel: Plus or minus 13 mm (1/2 inch).
3. Top Elevation from Nominal Top Elevation: As follows:
   a. Exposed Individual Panel: Plus or minus 6 mm (1/4 inch).
b. Nonexposed Individual Panel: Plus or minus 13 mm (1/2 inch).
c. Exposed Panel Relative to Adjacent Panel: 6 mm (1/4 inch).
d. Nonexposed Panel Relative to Adjacent Panel: 13 mm (1/2 inch).
4. Support Elevation from Nominal Support Elevation: As follows:
a. Maximum Low: 13 mm (1/2 inch).
b. Maximum High: 6 mm (1/4 inch).
5. Maximum Plumb Variation over Lesser of Height of Structure or 30 m (100 Feet): 25 mm (1 inch).
6. Plumb in Any 3 m (10 Feet) of Element Height: 6 mm (1/4 inch).
8. Joint Width (Governs over Joint Taper): Plus or minus 6 mm (1/4 inch).
10. Joint Taper in 3 m (10 Feet): 6 mm (1/4 inch).
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 6 mm (1/4 inch).

3.4 FIELD QUALITY CONTROL
A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
   1. Erection of loadbearing precast concrete members.
B. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and inspections and prepare reports.
   1. Field welds will be subject to visual inspections and dye penetrant or magnetic particle testing in accordance with ASTM E 165 or ASTM E 1444. Testing agency shall be qualified in accordance with ASTM E543.
   2. Testing agency will report test results promptly and in writing to Contractor and Architect.
C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
D. Additional testing and inspecting, at Erector’s expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS
A. Repair exposed exterior surfaces of precast architectural concrete units to match color, texture, and uniformity of surrounding precast architectural concrete if permitted by Architect.
B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).
C. Remove and replace damaged precast architectural concrete units if repairs do not comply with requirements.
3.6 CLEANING

A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.

1. Wash and rinse according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete masonry units.
   2. Mortar and grout.
   3. Steel reinforcing bars.
   5. Embedded flashing.
   6. Miscellaneous masonry accessories.
   7. Masonry-cell fill.

B. Related Requirements:
   1. Division 01 Section "Special Inspections and Tests" for independent testing agency procedures and administrative requirements.
   2. Section 033000 "Cast-in-Place Concrete".

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

C. Informational Submittals:
   1. Qualification Data: For testing agency.
   2. Material Certificates: For each type and size of the following:
      a. Masonry units.
         1) Include [data on material properties] [material test reports substantiating compliance with requirements].
         2) For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
      b. Cementitious materials. Include name of manufacturer, brand name, and type.
      c. Mortar admixtures.
d. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
e. Grout mixes. Include description of type and proportions of ingredients.
f. Reinforcing bars.
g. Joint reinforcement.
h. Anchors, ties, and metal accessories.

3. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   a. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
   b. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

4. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

5. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE
   A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
   B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
   C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
   D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
   E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS
   A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
      1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
   B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg. F (4 deg. C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.


PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS
A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
   2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

2.3 UNIT MASONRY, GENERAL
A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.
C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
   1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.
2.4 CONCRETE MASONRY UNITS
   A. Regional Materials: CMUs shall be manufactured within 500 miles (800 km) of Project site.
   B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
      1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
      2. Provide square-edged units for outside corners unless otherwise indicated.
   C. CMUs: ASTM C 90.
      1. Unit Compressive Strength: Refer to structural drawings.
      2. Density Classification: Normal weight unless otherwise indicated.
      3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less-than-nominal dimensions.

2.5 CONCRETE AND MASONRY LINTELS
   A. General: Provide one of the following:
   B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.
   C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.
   D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS
   A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
      1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
   B. Hydrated Lime: ASTM C 207, Type S.
   C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
   D. Masonry Cement: ASTM C 91/C 91M.
   E. Mortar Cement: ASTM C 1329/C 1329M.
   F. Aggregate for Mortar: ASTM C 144.
      1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
      2. For joints less than 1/4-inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
      3. White-Mortar Aggregates: Natural white sand or crushed white stone.
      4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M.
   1. Interior Walls: Hot-dip galvanized carbon steel.
   2. Exterior Walls: [Hot-dip galvanized carbon] steel.
   3. Wire Size for Side Rods: 0.187-inch (4.76-mm) diameter.
   4. Wire Size for Cross Rods: 0.187-inch (4.76-mm) diameter.
   5. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
   6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

2.8 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into masonry but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
   3. Stainless-Steel Wire: ASTM A 580/A 580M, [Type 304] [Type 316].
   6. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, [Type 304] [Type 316].
   7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, [hot-dip galvanized steel] [stainless-steel] wire.[Mill-galvanized wire may be used at interior walls unless otherwise indicated.]
   2. Tie Section: Triangular-shaped wire tie made from [0.187-inch- (4.76-mm-)] [0.25-inch-(6.35-mm-)] diameter, [hot-dip galvanized steel] [stainless-steel] wire.[Mill-galvanized wire may be used at interior walls unless otherwise indicated.]
D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from [0.060-inch (1.52-mm)] thick steel sheet, galvanized after fabrication] [0.105-inch (2.66-mm)] thick steel sheet, galvanized after fabrication] [0.062-inch (1.59-mm)] thick, stainless-steel sheet] [0.109-inch (2.78-mm)] thick, stainless-steel sheet].
   a. [0.064-inch (1.63-mm)] [0.108-inch (2.74-mm)] thick, galvanized steel sheet may be used at interior walls unless otherwise indicated.

2. Tie Section: Triangular-shaped wire tie made from [0.187-inch (4.76-mm)] [0.25-inch (6.35-mm)] diameter, [hot-dip galvanized steel] [stainless-steel wire]. [Mill-galvanized wire may be used at interior walls unless otherwise indicated.]

E. Partition Top Anchors: 0.105-inch (2.66-mm) thick metal plate with a 3/8-inch (9.5-mm) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from [steel, hot-dip galvanized after fabrication] [stainless steel].

F. Rigid Anchors: Fabricate from steel bars [1-1/2 inches (38 mm) wide by 1/4 inch (6.35 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated] [bent to configuration indicated].
   1. Corrosion Protection: [Hot-dip galvanized to comply with ASTM A 153/A 153M] [Epoxy coating 0.020 inch (0.51 mm) thick] [Rust-inhibitive paint].

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from [neoprene] [urethane] [or] [PVC].

B. Preformed Control-Joint Gaskets: Made from [styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805] [or] [PVC, complying with ASTM D 2287, Type PVC-65406] and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use [portland cement-lime] [masonry cement] [or] [mortar cement] mortar unless otherwise indicated.
   3. For exterior masonry, use [portland cement-lime] [masonry cement] [or] [mortar cement] mortar.
   4. For reinforced masonry, use [portland cement-lime] [masonry cement] [or] [mortar cement] mortar.
   5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, [Proportion] [Property] Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry:
   1. For brick masonry, use Type O, 350 psi.
   2. For non-load bearing concrete masonry units and spandrel panels, use Type N, 750 psi.
   3. Above grade load bearing concrete masonry units, use Type S, 1800 psi.
   4. For masonry below grade or in contact with earth, use Type M, 2500 psi.

D. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C 476, [Table 1] [or] [paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa)].
   3. Provide grout with a slump of [8 to 11 inches (200 to 280 mm)] [10 to 11 inches (250 to 280 mm)] as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm).

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS
A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (100 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
E. **Built-in Work:** As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. **Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.**

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. **Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.**

I. **Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.**
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
   3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

### 3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

### 3.6 MASONRY-JOINT REINFORCEMENT

A. **General:** Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
   1. Space reinforcement not more than 16 inches (406 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
C. Provide continuity at wall intersections by using prefabricated T-shaped units.
D. Provide continuity at corners by using prefabricated L-shaped units.
E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
   1. Provide an open space not less than [1/2 inch (13 mm)] [1 inch (25 mm)] [2 inches (50 mm)] wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.8 LINTELS

A. Provide masonry (CMU) lintels where shown and where openings of more than 12-inches (305 mm) for brick-size units and 24-inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.9 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 48-inch lifts.

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
B. Inspections: Special inspections according to Level [B] [C] in TMS 402/ACI 530/ASCE 5.
1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for [mortar air content] and [compressive strength].

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at [7 days and at 28 days].

### 3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

### 3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

   END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Structural steel.
   2. Grout.

B. Related Sections include the following:
   1. Section 014100 “Special Inspections and Tests” for code-required testing and inspections.
   2. Section 053123 – Steel Roof Decking.
   3. Section 055000 – Metal Fabrications.
   4. Section 099123 – Interior Painting.
   5. Section 099600 – High-Performance Coatings.

1.2 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC’s "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.3 SUBMITTALS

A. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Include embedment drawings.
   3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
   4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
   5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and registered in state in which construction is located.

B. Certifications: Furnish certification from fire proofing manufacturer stating compatibility with shop paint primer.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code—Steel."

B. Comply with applicable provisions of the following specifications and documents:
   1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
   1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
   2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
C. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand code loads indicated and comply with other information and restrictions indicated.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992, Grade 50.
B. Channels, Angles, Plate and Bar: ASTM A 36.
C. Corrosion-Resisting Structural Steel: ASTM A 588, Grade 50.
D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
E. Steel Pipe: ASTM A 53, Type E or S, Grade B, Finish: Black, except where indicated to be galvanized.
F. Welding Electrodes: E70XX, comply with AWS requirements.
2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
   1. Finish: Plain.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

C. Shear Connectors or Headed Concrete Anchors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

D. Unheaded Anchor Rods: [ASTM F 1554, Grade 36].
   5. Finish: Plain

E. Deformed Bar Anchors (DBA):
   1. Manufactures:
   2. ASTM A496, uniform diameter with minimum tensile strength of 80ksi.

F. Expansion Bolts:
   1. Manufactures:
      a. Liebig International, Ultraplus
      b. Hilti, Kwik-Bolts II
      c. ITW Ramset/Redhead, Trubolt
      d. Wej-it Expansion Products, Inc. Wej-it Bolts
   2. If embedment length is not indicated on the drawings, provide embedment length recommended by the manufacturer to develop full strength of bolt.

G. Adhesive Anchors into Hollow Masonry:
   1. Manufacturers:
      a. Hilti, HIT HY 150
   3. If embedment length is not indicated on the Drawings, provide embedment length recommended by manufacturer to develop full strength of bolt.

H. Adhesive Anchors into Solid Masonry or Concrete:
   1. Manufacturers:
      a. Hilti, HIT HY 150
   2. Rods:
      a. Standard rods per ASTM A36.
      b. Super rods per ASTM A193 Grade B7.
      c. Stainless steel rods per ASTM F593 Condition CW.
      d. Reinforcement bar per Section 03200.
3. If embedment length is not indicated on the Drawings, provide embedment length recommended by manufacturer to develop full strength of bolt.
4. Provide rods threaded full length with 45 degree bevel cut at base.

I. Self-lubricating Bearing Elements:
   1. Manufacturers:
   2. Composition of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates prebonded to appropriate steel backing materials, of size and thickness indicated on drawings.


2.4 PRIMER
   A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
   B. Galvanizing Repair Paint: ASTM A 780.
   C. Bituminous Protection Coating: Carboline, Bitumastic 50

2.5 GROUT
   A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION
      1. Camber structural-steel members where indicated.
      2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
      3. Mark and match-mark materials for field assembly.
      4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
   B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
      1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
   C. Bolt Holes: Cut, drill or punch standard bolt holes perpendicular to metal surfaces.
   D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
   E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning or SSPC-SP 2, "Hand Tool Cleaning."
   F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
   G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC’s "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened or as indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
   1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
   2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
   3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
      a. Grind butt welds flush.
      b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.
   4. Surfaces to receive sprayed fire-resistant materials.
   5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards SSPC-SP 2, "Hand Tool Cleaning." Or SSPC-SP 3, "Power Tool Cleaning."

C. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
   1. Fill vent holes and grind smooth after galvanizing.
   2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. See section 014000 for testing and inspection requirements.
B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:
   1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION


   1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of base plate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.

4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened or as indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
   2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
   3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.
      a. Grind butt welds flush.
      b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

C. Tension Control Devices:
   1. Install using electric power wrench as recommended by bolt manufacturer.
   2. Tighten until splined end of bolt is sheared off.
D. Expansion Bolts or Adhesive Anchors: Install according to manufactures published instructions.

E. Shear Connectors:
   1. Do not weld when the temperature is below 0 degrees F.
   2. Remove standing water in deck ribs so that water is not trapped between beams and deck during welding.
   3. Ensure that surfaces of steel beams to which studs are to be welded are dry and free of paint, dirt and debris and that deck bottom is in firm contact with beam.
   4. Install studs after steel framing and metal decking are in place.
   5. Use automatic welding equipment powered to weld studs satisfactorily under site conditions.
   6. Prior to starting each day’s operations, weld at least two shear studs to determine proper generator control unit and stud welder settings.
   7. Test that studs are capable of being bent 45 degrees from vertical without weld failure.
   8. Weld additional trial shear studs at request of ITL.

3.5 PREFABRICATED BUILDING COLUMNS

A. Install prefabricated building columns to comply with AISC’s "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" or "Load and Resistance Factor Design Specification for Structural Steel Buildings," manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: [Owner will engage] [Engage] a qualified special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
   1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than- continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1.
E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.7 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Roof deck.

B. Related Sections include the following:
   1. Section 014100 “Special Inspections and Tests” for code-required testing and
      inspections.
   2. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous
      steel shapes.
   3. Division 09 painting Sections for repair painting of primed deck.

1.2 SUBMITTALS

A. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing
   channels, pans, cut deck openings, special jointing, accessories, and attachments to other
   construction.

B. Research/Evaluation Reports: ICBO Approval Number for steel deck.

1.3 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding
   Code - Sheet Steel."

B. AISI Specifications: Comply with calculated structural characteristics of steel deck according to
   AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

C. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide,
   Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

D. Recycled Content of Steel Products: Provide products with an average recycled content of
   steel products so postconsumer recycled content plus one-half of preconsumer recycled content
   is not less than 25 percent.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and
   handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a
   waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to
      maintain insulation free of moisture.
PART 2 - PRODUCTS

2.1 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
   a. Color: Manufacturer's standard

2. Galvanized Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 zinc coating.

3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

4. Deck Profile: As indicated.

5. Cellular Deck Profile: As indicated, with bottom plate.

6. Profile Depth: As indicated.

7. Design Uncoated-Steel Thickness: As indicated.

8. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated

9. Span Condition: Triple span or more unless otherwise indicated on drawings.

10. Side Laps: Overlapped.

2.2 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Galvanizing Repair Paint: ASTM A 780.

G. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
   1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Mechanical Fasteners:
   1. Attach metal deck to supports with mechanical fasteners spaced as indicated on drawings.
   2. Install mechanical fasteners according to manufacturer's published instructions and recommendations.
   3. Pretest each different condition of attachment, such as different supporting member thickness, to determine proper installation prior to actual installation.
   4. Mechanically fasten side laps of decking together at center of spans or as indicated on drawings.
   5. Use self-tapping screws for both interlocking side laps and simple overlaps.
   6. Where structure thickness exceeds ½ inch diameter puddle welds with same spacing as mechanical fasteners.

B. Welding:
   1. Weld deck to perimeter supports with full fused 5/8 inch diameter puddle welds, ½ inch effective, at 6 inches on center.
   2. Weld deck to interior supporting steel members with full fused 5/8 inch diameter puddle weld, ½ inch effective, at both side flutes and at every other interior flute at 12 inches on center maximum.
   3. Provide minimum of four welds at each supports for sheets 30 inches wide, minimum of three welds at each support for sheets 24 inches wide.
   4. Weld side laps of decking together at center of spans or as indicated on the drawings.
      b. Arc seam or fillet weld: 1 inch long.
   5. Cover weld burn holes with metallic tape.
C. Powder Driven Fasteners:
   1. Install according to manufacturer’s published instructions and recommendations.
   2. Pretest each different condition of attachment with manufacturer’s representative present, such as different supporting member thickness, to determine proper fastener types prior to actual installation.
   3. If during pretesting of attachment conditions fasteners system is failing, consult Architect as to what deck fastening alternatives are acceptable.
   4. Mechanically fasten side laps of decking together at center of spans or as indicated on drawings.
   5. Use self-tapping screws for both interlocking side laps and simple overlaps.
   6. Where structure thickness exceeds 1/2 inch, weld deck to support with minimum effective 1/2 inch diameter puddle welds with same spacing as mechanical fasteners.

D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Lapped 2 inches minimum.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection for size, quality and spacing.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on bottom surface of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Miscellaneous framing and supports for elevator equipment.
   2. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
   3. Shelf angles.
   4. Loose bearing and leveling plates.
   5. Loose steel lintels.
   6. Metal ladders.
   7. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
   8. Slotted channel framing.

B. Related Sections:
   1. Section 051200 – Structural Steel Framing, for structural steel.
   2. Section 079200 – Joint Sealants.
   4. Section 099123 – Interior Painting.
   5. Section 142400 – Hydraulic Elevators.
   6. Section 321313 – Concrete Paving, for adjacent paving.

1.2 REFERENCES

A. American Welding Society (AWS)
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.2 - Structural Welding Code - Aluminum.
   3. D1.6 - Structural Welding Code - Stainless Steel.

B. ASTM International (ASTM)
   4. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   5. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   7. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

C. National Association of Architectural Metal Manufacturers (NAAMM)
   1. AMP 503 - Finishes for Stainless Steel.
   2. AMP 510 – Metal Stairs Manual.

1.3 SUBMITTALS
A. Product Data: For the following:
   1. Shop primers.
   2. Cementitious products.
B. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   2. Provide templates for anchors and bolts specified for installation under other Sections.
   3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE
A. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.5 PROJECT CONDITIONS
A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION
A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MATERIALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Plate: Products complying with ASTM A666, Type 304.

D. Stainless-Steel Bars and Shapes: Products complying with ASTM A276, Type 304.

E. Hollow Structural Sections: Products complying with ASTM A 1085, or ASTM A 500.

F. Steel Tubing: ASTM A 500, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

H. Fasteners: Select and provide fasteners for fastening steel components to base materials, of type and size required to support loads, anchor components to substrates indicated, and develop proper friction, keying, and bonding.
   1. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
   2. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.
   3. Anchor Bolts: ASTM F 1554, Grade 36.
      a. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

I. Post-Installed Anchors for Concrete: Select and provide post-installed mechanical expansion and chemical adhesive anchors as required to accommodate loads indicated and as follows:
   1. Provide products designed per ACI 318-11.

3. Chemical Adhesive Anchors: Tested and qualified according to ACI 355.4, with a current report under ICC-ES AC 308.

4. Material: Stainless Steel (exterior); hot-dip galvanized (interior).

J. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

K. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with ASTM A 780 and SSPC-Paint 20, and compatible with successive top coats., for regalvanizing welds in steel.
   1. Acceptable Product:
      a. ZRC Wordwide, ZRC Galvilite.

L. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

M. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

N. Separation Tape: Vinyl or low-density polyethylene tape designed for construction metal separation, splicing and sealing; providing permanent barrier between dissimilar metals preventing electrolytic corrosion; UV and moisture resistant with flexible adhesive providing permanent seal, for outdoor application.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.4 ELEVATOR STEEL FRAMING AND SUPPORTS

A. General: Provide steel framing and supports related to elevator work indicated, including elevator machine beams, hoist beams, and divider beams; steel shapes for supporting elevator door sills; and elevator rail guide plates and angles.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Prime interior miscellaneous framing and supports with specified rust-inhibitive primer, unless indicated otherwise.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts if units are installed after concrete is placed.

C. Galvanize miscellaneous framing and supports in exterior walls, unless otherwise indicated.

D. Prime miscellaneous framing and supports with specified rust-inhibitive primer at interior conditions, unless otherwise indicated.

2.6 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

2.7 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.8 METAL LADDERS AND GATES

A. Interior Steel Elevator Pit Access Ladders:
   1. Space siderails 18 inches (457 mm) apart (inside dimension) unless otherwise indicated.
2. Space siderails of elevator pit ladders 12 inches (300 mm) apart.
3. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
4. Rungs: 3/4-inch- (19-mm-) diameter steel bars.
5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
6. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.

2.9 SLOTTED CHANNEL FRAMING
A. Slotted Framing Channels: Cold-formed metal channels with continuous slot complying with MFMA-4.
   1. Acceptable Manufacturers: One of the following:
      a. Cooper B-Line
      b. Flex-Strut Inc.
      c. Hilti, Strut Systems.
      d. Powerstrut.
      e. Unistrut.
   2. Material: Steel complying with ASTM A 1011 Grade 33; or ASTM A 1008/A 1008M, commercial steel, Type B structural steel, Grade 33 (Grade 230);
   3. Size of Channels: As required by structural analysis, but not less than 1-5/8 by 1-5/8 inches (41 by 41 mm).
   4. Thickness: Minimum 0.0966-inch (2.5-mm).
   5. Finish: Manufacturer's factory rust-inhibitive, baked-on, acrylic enamel.
B. Framing Accessories: Provide manufacturers accessories and fittings as required for a complete installation, including channel nuts, inserts, end caps, swivel and swing fittings, supports, joiners, and brackets.

2.10 STEEL FINISHES
A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   1. ASTM A 123/A 123M, for galvanizing steel and iron products.
   2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
B. Preparation for Field Coating: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:
   1. Interior Steel: SSPC-SP 3, "Power Tool Cleaning."
      a. Profile Height of Prepared Surfaces: 1- to 3-mils.
C. Paint Preparation for Galvanized Steel: For newly prepared zinc-coated steel that has been hot dip galvanized after fabrication and within 48 hours of painting, prepare surfaces in the shop for painting according to ASTM D 6386, and as follows:
   1. Do not water- or chromate-quench; do not oil.
   2. Provide slightly roughened surface using profiling methods, such as filing high spots, sweep blasting, phosphating, and using wash primers or acrylic passivations, as required to improve paint adhesion, taking measure to prevent damage to galvanized coating.

D. Shop Primer for Galvanized Steel: Water based metal primer, composed of anti-corrosive pigments and acrylic resins, for cleaned/etched galvanized metal.
   1. Acceptable Products: One of the following; and compatible and acceptable by manufacturer of finish coat used for this application.
      a. Sherwin-Williams, Pro Industrial, Pro-Cryl Universal Primer.
      b. Benjamin Moore, Super Spec High Performance Acrylic Metal Primer.
      c. PPG Architectural, Pitt-Tech Plus, 100% Acrylic DTM Industrial Primer.

E. Zinc-Rich Shop Primer (Exterior Work): Product complying with SSPC-Paint 20, and as follows:
   1. Vehicle Type: Inorganic, Type-1.
   2. Zinc Dust Level: Level 2 (equal or greater than 77-percent, not more than 85-percent).
   3. VOC Limit: Not more than 420 g/L (3.5 lb/gal.) when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Shop Primer (Interior Work): Rust-inhibitive, water-based primer, emulsion type, anti-corrosive primer for interior or exterior ferrous metals exposed to mildly corrosive environments. Coating shall be resistant to flash rusting when applied to cleaned steel.
   1. Vehicle Type: Acrylic.
   2. VOC Limit: Not more than 250-g/L (2.3-lb/gal) when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. Color: Manufacturer's standard light or medium gray.
   4. Film Thickness: Minimum 3.5-mils (88-microns) dry film thickness.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
   1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
   1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLING SLOTTED CHANNEL FRAMING

A. Install framing to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
   1. Install shop- or field-fabricated, slotted channel framing and securely anchor to supporting structure.
   2. Install slotted channel framing and accessories plumb, square, and true to line, and with connections securely fastened.
3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION
SECTION 061053
MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

B. Related Sections:
   1. Section 076200 – Sheet Metal Flashing and Trim

1.2 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project, from ICC-ES:
   1. Preservative-treated wood.
   2. Power-driven fasteners.
   3. Post-installed anchors.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

1.4 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   3. Provide dressed lumber, S4S, unless otherwise indicated.
1.5 WOOD-PRESERVATIVE-TREATED WOOD
A. General: Provide wood-preservative treatments by pressure process for wood materials in exterior wall and roof assemblies.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
B. Pressure Preservative Treatment: Micronized copper azole, AWPA type CBA-A, pressure treatment consisting of copper, boric acid, and tebuconazole, using a water-based carrier.
   1. Acceptable Products: One of the following:
      b. Osmose MicroPro SmartSense.
   2. Extent of Treatment: Wood nailers, blocking, rooftop support curbs, and plywood at roofing, parapets, in exterior walls, and in contact with cementitious materials.
C. Kiln-dry lumber after treatment to a maximum moisture content of 19-percent. Do not use material that is warped or does not comply with requirements for untreated material.
D. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1.6 FASTENERS
A. Fasteners and Anchors, General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Select and provide fasteners for fastening panel and substructure components to base materials, that have the duty-level to support loads and develop proper friction, keying, and bonding.
   2. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
B. Post-Installed Anchors for Concrete: Select and provide post-installed mechanical expansion and chemical adhesive anchors as required to accommodate loads indicated and as follows:
   1. Provide products designed per ACI 318-11.
   3. Chemical Adhesive Anchors: Tested and qualified according to ACI 355.4, with a current report under ICC-ES AC 308.

1.7 MISCELLANEOUS MATERIALS
A. Construction Adhesives: Formulation complying with APA AFG-01 and with ASTM D 3498 that is approved for use indicated by adhesive manufacturer; and with VOC content of 70 g/L or less.
   1. Acceptable Products: One of the following:
      b. ITW TACC, Miracle Lumberlock G E72.
      c. Liquid Nails, LN-903/LNP-903.
PART 2 - EXECUTION

2.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

C. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

D. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

E. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC’s International Building Code.

F. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

2.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

2.3 PROTECTION

A. Protect preservative-treated wood in accordance with treatment manufacturer’s recommendations. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Building thermal insulation for the following applications:
      a. Below-grade walls and slabs on grade.
      b. Exterior wall insulating sheathing.
   2. Wall and ceiling vapor retarders.

B. Related Sections: The following Sections contain requirements that relate to this Sections:
   1. Section 033000 – Cast-in-Place Concrete, for below-slab vapor retarders.
   2. Section 042000 – Unit Masonry, for masonry cavity wall insulation.
   3. Section 075323 - EPDM Roofing, for roof assembly insulation.
   4. Section 079200 – Joint Sealants, for joint sealing, including sill sealer gasketing.

1.2 SUBMITTALS

A. Manufacturer’s Product Data: For each type of product indicated and used in the work of this Project.

B. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence compliance of foam-plastic insulations with building code in effect for Project.

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work, whenever possible.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, sun exposure, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
   3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
2.1 SYSTEM DESCRIPTION / PERFORMANCE REQUIREMENTS

A. Continuous Insulation: Provide thermal insulation that is continuous across all structural members without thermal bridges other than fasteners and service openings; installed on the exterior and opaque surfaces of the building envelope.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

C. Fastening System for Exterior Insulating Sheathing and Cladding Attachment: Select and provide fastening systems through continuous insulation and rigid furring assemblies, of lengths, sizes, and duty-level, to transfer and support loads indicated, and as required to accommodate attached cladding assemblies.
   2. Provide engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   4. Insulation Thicknesses: As detailed on Drawings.

2.2 INSULATION PRODUCTS

A. INSUL-1B: Extruded Polystyrene Board Insulation: Product complying with ASTM C 578, and as follows:
   1. Acceptable Manufacturers: One of the following:
      a. DiversiFoam Products, Certifoam 25.
      b. Dow, Styrofoam SM.
      c. Owens Corning, Foamular 250.
      d. Pactiv Building Products, GreenGuard CM.
   2. Type IV, 25 psi (173 kPa).
   3. R-Value: R-5 per inch thickness.
   4. Thickness: 2 inches.
   5. Fire-Resistance: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
   6. Applications: Below-grade walls, and under slabs on grade other than waterproofing applications.

B. INSUL-6B: Low-Pressure, Polyurethane Foam Insulation: Complying with ASTM C 1029, and with AAMA document 812-04 to not bow or distort windows or doors:
   1. Acceptable Products: One of the following:
      a. Fomo, Handi-Seal,
      b. BASF,
      c. DOW Chemical,
      d. Johns Manville.
e. Other pre-approved Manufacturer.

2. Minimum density of 1.44 lb/cu.ft.

3. R-Value: Minimum R-4.2 per inch.

4. Fire-Resistance: Maximum flame-spread and smoke-developed indexes of 5 and 10, respectively, per ASTM E 84.

5. Applications:
   a. Insulation for filling gaps in openings and penetrations.

2.1 MISCELLANEOUS PRODUCTS AND ACCESSORIES

A. Insulation for Miscellaneous Voids: INSUL-6B specified in this Section.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

C. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical footing and foundation wall surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

3.4 INSTALLATION OF EXTERIOR WALL INSULATING SHEATHING

A. Installation of Insulation for Precast Veneer Walls: Specified in Section 034500.

B. Foam-Plastic Board Insulation: Install products in accordance with manufacturer's installation recommendations for conditions and substrates indicated for this Project.

1. Fasteners: Use types recommended by manufacturer for applications and substrates indicated.
2. Adhesives: Use types that are compatible with fluid-applied membrane air barriers. Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.

C. Precision cut and trim boards to fit, with joints taped and sealed as required to maintain a continuous thermal layer.
   1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
   2. Fill gaps greater than 1/8 inch with compatible spray foam insulation

3.5 SPRAY POLYURETHANE FOAM INSULATION INSTALLATION

A. Low-Pressure, Polyurethane Foam Insulation Installation: Apply spray-applied polyurethane foam insulation according to manufacturer's written instructions.
   1. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.
   2. Do not apply SPF insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
   3. Install insulation in miscellaneous voids and cavity spaces to prevent gaps in insulation. Seal cracks and crevices, penetrations, and areas in and around structural connections to exterior walls.

3.6 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
   1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) o.c.
   2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
   3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.7 FIELD QUALITY CONTROL

A. Engage a third-party field inspector to inspect installed insulation prior to gypsum wall board application. Installation quality interpreted according to Appendix A of RESNET Mortgage Industry National Home Energy Rating Systems Standards.
3.8 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION
SECTION 075323
EPDM ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Adhered EPDM membrane roofing system.

B. Related Sections:
   1. Section 033000 – Cast-in-Place Concrete, for concrete deck.
   2. Section 053123 – Steel Roof Deck, for steel deck.
   3. Section 076200 – Sheet Metal Flashing and Trim, for metal copings and counterflashing.
   4. Section 079200 – Joint Sealants, for installation of joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. Roofing Manufacturer: The manufacturer of primary membrane materials, and roofing system assembly.

B. Roofing Terminology: As defined in ASTM D 1079 definition of terms related to roofing work in this Section.

C. Continuous Air Barrier: The combination of interconnected materials, assemblies, and sealed joints and components of the building envelope that minimize air leakage into or out of the building envelope.

1.3 REFERENCES

A. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM International (ASTM)


1.4 SUBMITTALS

A. EPDM Roofing Submittal: Provide submittal that includes the following listed below packaged together. Label submittal and product information to match material codes used on Drawings.
1. Product Data: For each type of product specified used in the Work, including:
   a. Roof membrane.
   b. Flashing material.
   c. Pre-molded flashing accessories.
   d. Cover board.
   e. Adhesives.
   f. Vapor retarder.

2. Shop Drawings: Indicate the following:
   a. Setting plan for insulation.
   b. Roof slopes.
   c. Layout of seams.
   d. Base flashing, termination, and special details.
   e. Supplemental fastener types and locations, if any.

3. Warranty: Sample warranty form.

B. Field Quality Control Report: Copy of final roof inspection report from roofing manufacturer's technical service representative.

C. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

B. Source Limitations: Obtain components including roof insulation fasteners for membrane roofing system from same manufacturer as membrane roofing or approved by membrane roofing manufacturer.

C. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

D. Pre-Installation Roofing Conference: Conduct conference project site.
   1. Convene at site 2 weeks prior to beginning work of this Section.
      a. Notify attendees and coordinate meeting.
   3. Review and discuss Contract Documents, roofing system manufacturer's literature, project conditions, scheduling, and other matters affecting application.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

E. Project Conditions: Comply with roofing system manufacturer’s written recommendations.
1.6 WARRANTY

A. Furnish manufacturer’s warranty providing coverage against water leakage through roofing system, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period
   1. Warranty Period: 20 years from date of Substantial Completion.
   2. Make repairs to roofing system required due to defects in materials or workmanship resulting in water leakage into or through roofing system.
   3. Include cost of labor and materials necessary to make required repairs.
   4. Cover all roofing system components including roofing membrane, built-up and metal flashings, high wall waterproof flashings, roof insulation, and pre-flashed accessories.
   5. Not limited to specific dollar amount.
   6. Transferable to subsequent building owners during warranty period.
   7. Include coverage for specified wind speed.
   8. Provide warranty on manufacturer’s standard or customized form.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. EPDM Roofing System: Provide new roof system in extents and locations indicated, including the following assembly components:
   1. EPDM roof membrane.
   2. Roof cover board.
   3. Board insulation.
   4. Vapor retarder.
   5. Underlayment substrate board.

B. Performance Requirements, General: Provide roofing system that withstands specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Provide membrane roofing and base flashings to be watertight.
C. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

D. Structural Design: Provide membrane roofing system designed to resist minimum wind loads in accordance with ASCE/SEI 7 and as follows:

E. VOC Limits:
   1. Exterior-side liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
   2. Adhesives and sealants interior side of weather barrier:
      a. Single-Ply Roof Membrane Sealants: 250 g/L maximum.
      b. Nonmembrane Roof Sealants: 300 g/L maximum.

2.2 EPDM ROOFING

A. EPDM Roofing Membrane: Roofing manufacturer’s non-reinforced, uniform, flexible EPDM sheet complying with ASTM D 4637, Type I.
   1. Acceptable Products: One of the following:
      a. Carlisle SynTec, Sure-Seal.
      b. Firestone Building Products, Rubberguard.
      c. Johns Manville, JM EPDM NR.
      d. Versico, Versiguard.
      e. Genflex, EPDM.
   2. Thickness: 60 mils (1.5 mm), nominal.

B. Sheet Flashing: Roofing manufacturer’s 60-mil thick EPDM, partially cured or cured, non-reinforced, according to application.

C. Roof Cover Board: Glass-mat, water-resistant gypsum board complying with ASTM C 1177; factory primed, developed for roof cover board applications, and approved for use in roofing manufacturer’s roofing system.
   1. Acceptable Products: One of the following:
      a. GP Gypsum, DensDeck Prime.
      b. USG Securerock.
   2. Thickness: 1/2 inch.

D. Polyiso Board Insulation: Roofing manufacturer’s polisocyanurate board insulation, complying with ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces
   1. Compressive Strength: 20 psi.
   2. R-Value: 5.6 per inch (LTTR).
   3. Tapered Insulation: Factory-fabricated tapered insulation boards, fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
   4. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

E. Air and Vapor Retarder: Modified bituminous, vapor-retarding, 40-mil- (1.0-mm-) thick, smooth-surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.
2.3 ACCESSORY PRODUCTS

A. Miscellaneous Accessories: Provide roofing manufacturer's standard accessories as required to produce a complete roof system, including pourable sealers and fillers, preformed flashings, reinforced EPDM securement strips, in seam sealants, termination reglets, cover strips, and other accessories.
   1. Provide auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

B. Splash Blocks: Precast concrete units designed for roof drainage; profiled for drainage toward outside of block.

C. Metal Termination Bars: Predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

D. Membrane Bonding Adhesive: Roofing manufacturer's standard, low VOC, water-based or solvent-based contact adhesive used to attach membrane to substrate.
   1. VOC Content: Maximum 250 g/L.

E. Seaming Material: Roofing manufacturer's standard, synthetic-rubber polymer primer and 6-inch- (150-mm-) wide minimum, butyl splice tape with release film.

F. Lap Sealant: Manufacturer's standard, single-component sealant.

G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

H. Flashing Primer Material: Roofing manufacturer's standard synthetic-rubber polymer primer.

I. Flashing Adhesive: Roofing manufacturer's standard, low VOC, solvent-based contact adhesive used to attach flashings to membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system.
   1. Verify that surface plane flatness and fastening of steel roof deck complies with requirements.
   2. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are secure.
   3. Verify that wood blocking and nailers are securely anchored to roof deck at penetrations and terminations, and that nailers match thicknesses of insulation.
   4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
   5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION
A. Prepare surfaces as required to receive new roofing materials. Comply with manufacturer’s written recommendations.
   1. Remove projections that could puncture membrane from substrate.
   2. Clean substrate of loose and foreign material, oil, and grease.
B. Complete roof penetrations and preparation for drains, flashings, and other penetrations prior to beginning roofing.
C. Protect adjacent and underlying surfaces from damage imposed by roofing operations.

3.3 INSTALLATION, GENERAL
A. Install roofing system in accordance with roofing system manufacturer's instructions and approved Shop Drawings.

3.4 AIR BARRIER / VAPOR RETARDER INSTALLATION
A. Apply and firmly adhere modified bituminous sheets horizontally on to underlayment to receive vapor retarder. Accurately align sheets and maintain a uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure airtight installation.
   1. Apply sheets in a shingled manner toward roof drains without interception by any exposed sheet edges.
   2. Roll sheets firmly to enhance adhesion to substrate.
B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.5 INSULATION INSTALLATION
A. Apply base layer with long edges continuous and perpendicular to deck ribs. Stagger end joints in adjacent rows. Locate ends over solid bearing.
   1. Adhere to substrate in manufacturer's recommended adhesive.
B. Multi-layered Applications: Apply top layer with long edges perpendicular to those of base layer, with joints staggered in adjacent rows. Offset joints from those in base layer.
   1. Adhere top layer of insulation to bottom layer of insulation.

3.6 COVER BOARD INSTALLATION
A. Apply panels with long edges continuous and perpendicular to direction of insulation. Stagger end joints in adjacent rows. Offset joints from those in insulation.
B. Adhere to substrate in manufacturer's recommended adhesive.
C. Fit panels to other panels and at perimeter and around penetrations with maximum 1/4 inch voids.

3.7 ROOF MEMBRANE INSTALLATION
A. Position sheets without stretching; minimize wrinkles. Allow membrane to relax before proceeding.
B. Adhere roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeters.

F. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.
   1. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

G. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.

H. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

I. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal membrane roofing in place with clamping ring.

J. Provide supplementary mechanical fastening at roof perimeters, in locations and configurations indicated on approved shop drawings.

K. Daily Protection: Ensure that water does not flow beneath completed sections of roof. Temporarily seal loose edge of membrane with night seal when weather is threatening. When work is resumed, pull sheet free before continuing installation.

3.8 INSTALLATION OF FLASHINGS

A. Construct in accordance with roofing system manufacturer's standard details.

B. Juncture of Horizontal and Vertical Surfaces:
   1. Use longest practical length flashing to minimize joints.
   2. Complete splice between flashing and main roof sheet before bonding flashing to vertical surface. Extend splice 3 inches beyond fasteners that attach membrane to horizontal surface.
   3. Adhere flashing to substrate with full bed of adhesive.
   4. Fasten top of flashing at 12 inches on center maximum, under metal flashing.

C. Penetrations through Membrane:
   1. Flash pipe with premolded pipe flashings wherever possible.
   2. Where molded pipe flashings cannot be installed, use field fabricated pipe seals.
   3. Seal clusters of pipes and unusually shaped penetrations with minimum 2-inch high flashing containing pourable sealer.

D. Roof Drains: Taper insulation around drain to provide smooth transition from roof surface to drain clamping ring. Seal between membrane and drain base with water cutoff mastic.
3.9 FIELD QUALITY CONTROL
A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTING AND CLEANING
A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION
SECTION 076200  
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sheet metal flashing and trim for roof and parapet applications.

B. Related Sections:
   1. Section 061053 – Miscellaneous Rough Carpentry, for wood blocking.
   2. Section 075323 – EPDM Roofing.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. 611 - Voluntary Specification for Anodized Architectural Aluminum


C. ASTM International (ASTM):

D. Sheet Metal and Air Conditioning Manufacturer's Association International (SMACNA).

E. National Roofing Contractors Association (NRCA), "The NRCA Roofing Manual".

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
   1. Color Charts: For pre-finished metals for selection by Architect from manufacturer's full range of options.

B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
   1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.

C. Samples: Physical samples of the following flashing, sheet metal, and accessory items:
   1. Sheet Materials: 6-inch-square samples of specified sheet materials to be exposed as finished surfaces.

D. Informational Submittals:
1. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
2. Sample Warranty: For special warranty.

E. Closeout Submittals:
1. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.5 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.
C. Provide anchorage to substrate and necessary modifications to meet specified and drawn requirements and maintain visual design concepts in accordance with Contract Documents and following installation methods as stipulated in SMACNA.
1. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
2. Make modifications only to meet field conditions and to ensure fitting of system components.
4. Provide concealed fastening.
5. Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between units and building structure or between components themselves.
6. Accommodate building structure deflections in system connections to structure.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 10-years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. System shall accommodate movement of components without buckling, failure of joint seals, undue stress on fasteners, or other detrimental effects when subjected to seasonal temperature changes and live loads.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install [copings] [roof edge flashings] tested according to SPRI ES-1 and capable of resisting the following design pressure:
   1. Design Pressure: As indicated on Structural Drawing S001.

D. Design system capable of withstanding building code requirements for negative wind pressure.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

2.2 MATERIALS

A. SFM-1: Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required; temper as required to suit forming operations and performance required.
   1. Exposed Coil-Coated Finishes: Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ written instructions.
   2. Color: To be selected from Manufacturer’s standard colors.
   3. Metal Thicknesses: As specified for type of fabrication indicated.

B. SFM-2: Galvanized Steel Sheet: Zinc-coated (galvanized) steel, ASTM A 653/A 653M, G90 (Z275) coating designation, prepainted by coil-coating process per ASTM A 755/A 755M.
   1. Surface: Smooth, flat.
   2. Exposed Coil-Coated Finishes: Two-coat fluoropolymer, complying with AAMA 620, not less than 70 percent PVDF resin by weight in color coat.
   3. Concealed Finish: Manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat.
   4. Color: To be selected from Manufacturer’s standard colors.
   5. Metal Thicknesses: As specified for type of fabrication indicated.
2.3 MISCELLANEOUS MATERIALS

A. Felt Underlayment: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.

B. Self-Adhering Sheet Underlayment, High Temperature: Butyl based and compatible with adjacent materials; slip-resisting-polyethylene surfaced; with release paper backing; cold applied. Stable after testing at 240 deg. F (116 deg. C) and passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
  1. Minimum Thickness: 30 mil.
  2. Tensile Strength: ASTM D 412 (Die C Modified); 250 psi.
  3. Membrane Elongation: ASTM D412 (Die C Modified); 250%.
  4. Permeance (Max): ASTM E96; 0.05 Perms.
  5. Acceptable Products:
     a. Carlisle, CCW MiraDRI WIP 300 High Temperature.

C. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

D. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
  1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
     a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
     b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
     c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
  4. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, solvent-release butyl rubber sealant.

G. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION, GENERAL

A. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
  1. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates.
B. Seams for Painted Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer or elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

C. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

E. Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

2.5 SHEET METAL FLASHING AND TRIM

A. General: Fabricate sheet metal flashings in profiles and configurations indicated on Drawings

1. Drawings: A631 through A640.

B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight.

1. Shop fabricate interior and exterior corners.
2. Coping Profile: Indicated on Drawings.
3. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
4. Fabricate from the Following Materials:
   a. Aluminum: 0.050 inch (1.27 mm) thick.
   b. Galvanized Steel: 0.040 inch (1.02 mm) thick.

C. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof.

1. Fasten gravel guard angles to base of scupper.
2. Fabricate from the following materials:
   a. Aluminum, 0.040 inch (1.02 mm).
   b. Galvanized Steel, 0.028 inch (0.71 mm) thick.

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows.

1. Fabricate from the following materials:
   a. Aluminum: 0.032 inch (0.81 mm) thick.
   b. Galvanized Steel: 0.028 inch (0.71 mm) thick.

E. Base Flashing: Shop fabricate interior and exterior corners.

1. Fabricate from the following materials:
   a. Aluminum: 0.040 inch (1.02 mm) thick.
   b. Galvanized Steel: 0.028 inch (0.71 mm) thick.

F. Counterflashing: Shop fabricate interior and exterior corners.
1. Fabricate from the following materials:
   a. Aluminum: 0.032 inch (0.81 mm) thick.
   b. Galvanized Steel: 0.022 inch (0.56 mm) thick.

G. Flashing Receivers: Fabricate from the following materials:
   1. Aluminum: 0.032 inch (0.81 mm) thick.
   2. Galvanized Steel: 0.022 inch (0.56 mm) thick.

H. Downspouts: Fabricate from the following materials:
   1. Aluminum: 0.032 inch (0.81 mm) thick.
   2. Galvanized Steel: 0.022 inch (0.56 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.

5. Torch cutting of sheet metal flashing and trim is not permitted.

6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation.

1. Coat back side of sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

I. Seal joints as shown and as required for watertight construction. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant.

1. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

J. Fabricate nonmoving seams in sheet metal with flat-lock seams.
3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
   1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.

C. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch (25 mm) below scupper discharge.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
   1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.

D. Counterflashing and Reglets: Install reglets to receive counterflashing in manner and by methods indicated. Where shown in masonry, furnish reglets to trades of masonry work, for installation as work of Division 04 sections.
   1. Fabricate counterflashings and reglets as 2-piece assemblies to permit installation of counterflashing after base flashings are in place.
   2. Fabricate reglets of same metal and thickness as counterflashings.
   3. Overlap roof base flashing 4 inches (100 mm) minimum.
   4. Install bottom edge tight against base flashing.
   5. Lap seam vertical joints 3 inches (75 mm) minimum and apply sealant.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering. Clean and neutralize flux materials. Clean off excess solder. Clean off excess sealants.

B. Remove temporary protective coverings and strippable films. Maintain in a clean condition during construction.

C. Replace sheet metal flashing and trim that have been damaged beyond minor repair.

END OF SECTION
SECTION 078413
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.
   2. Penetrations in smoke barriers.

B. Related Sections:
   1. Section 078443 – Joint Firestopping.
   2. Section 079200 – Joint Sealants.

C. Unit Prices:
   1. Work of this Section is affected by unit prices.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Firestop System and Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
   1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

C. Informational Submittals:
   1. Qualification Data: For Installer.

D. Closeout Submittals:
   1. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm qualified by one of the following:
   1. Approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors."
   2. Holds a valid certificate from UL’s "Qualified Firestop Contractor Program."

B. Preinstallation Meetings:
   1. Preinstallation Conference: Conduct conference at Project site.

C. Project Conditions:
   1. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system.
manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

2. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

D. Coordination:
   1. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
   2. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified installer, as defined in Quality Assurance Article, to select and provide penetration firestopping, using performance requirements and design criteria indicated.

B. Fire-Test-Response Characteristics:
   1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
      a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
         1) UL in its "Fire Resistance Directory."
         2) Intertek Group in its "Directory of Listed Building Products."
         3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
   1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.


2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Urethane joint sealants.
   3. Latex joint sealants.
   4. Polysulfide (Immersible) sealants.
   5. Maintenance of existing sealant joints.

B. Related Sections:
   1. Section 034500 – Architectural Precast Concrete.
   2. Section 042000 – Unit Masonry.
   4. Section 076200 – Sheet Metal Flashing and Trim.
   5. Section 078413 – Penetration Firestopping, for firestopping sealants.

1.2 REFERENCES

A. ASTM International (ASTM)

1.3 SUBMITTALS

A. Joint Sealant Submittal: Combine product data with Contractor’s proposed sealant application schedule, including the following:
   1. Application Schedule:
      a. Joint location or designation correlated to sealant manufacturer and product name.
      b. Type of sealant backing material.
      c. Joint preparation required or anticipated, including priming
   2. Joint-sealant formulation. Product Data: For each type of joint-sealant product indicated, including:
3. Sealant Manufacturer’s Color Charts: For each type of sealant product exposed to view, submit strips of cured sealants indicating the full range of available colors.
   a. Architect will make sealant color selections based on field review of adjacent surfaces.

4. Sample warranty.

B. Field-Adhesion Test Reports: For each sealant application tested.

C. Closeout Submittals:
   1. Operation and Maintenance Data: For joint sealants to include in maintenance manuals.
   2. Special warranties specified in this Section.
      a. Joint Sealant: One cartridge set for each color joint sealant specified.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer’s authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.
   1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
   2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

D. Mockup Coordination: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

E. Pre-Installation Conference:
   1. Review schedule for renovating sealants and coordination with other renovation work items.

F. Project Conditions: Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.
1.5 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Periods:
      a. Polyurethane Exterior Building Sealants: 5-years from date of Substantial Completion.
      b. Silicone Exterior Building Sealants: 20-years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 JOINT SEALANTS, GENERAL

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing
according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

2.4 SILICON JOINT SEALANTS

A. Single-Component, Stain-Resistant, Low-Modulus Neutral-Curing, Silicone Sealant:
   1. Products: One of the following, and SWRI-validated:
      a. Dow Corning Corporation; 790.
      b. GE SilPruf LM SCS2700.
      c. Tremco, Spectrem 1.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Use Related to Exposure: NT (nontraffic).
   5. Color: Selected by Architect from manufacturer’s full range of options.
   6. Applications:
      a. Exterior vertical control and expansion joints in unit masonry.
      b. Exterior perimeter joints between masonry and frames of doors windows and louvers.

B. Single-Component, Stain-Resistant, Moisture-Curing or Neutral-Curing, Silicone Sealant:
   1. Products: One of the following, and SWRI-validated:
      a. Dow Corning Corporation; 756 SMS Building Sealant.
      b. GE SilPruf NB SCS 9000.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Use Related to Exposure: NT (nontraffic).
   4. Applications:
      a. Exterior joints in metal panel substrates.
   5. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
   6. Color: Selected by Architect from manufacturer’s full range of options.

2.5 URETHANE JOINT SEALANT

A. Polyurethane Sealant: 1-Part Polyurethane elastomeric sealant, complying with ASTM C-920, Type S, Class 25, Grade NS.
   1. Acceptable Manufacturers and Products:
      b. Sonneborn Building Products: Sonolastic NP-1.
      c. Tremco Incorporated: Dymonic.
      d. Pecora Corporation: Dynatrol I.
      e. Tremco Incorporated: Vulkem 116.

2.6 LATEX JOINT SEALANTS

A. Acrylic Sealant: Latex sealant complying with ASTM C 834, and as follows:
1. Products: One of the following:
   a. Sonneborn Sonolac.
   c. Tremco Tremflex 834.

2. Applications: Use for perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.

3. Color: Selected by Architect from manufacturer’s full range of options.

B. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. DAP Inc.; 100 percent Silicone Kitchen and Bath Sealant.
   b. Dow Corning Corporation; Dow Corning 786.
   c. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
   e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
   f. BASF Building Systems; Omniplus.
   g. GE Advanced Materials - Silicones; Sanitary SCS1700.
   h. May National Associates, Inc.; Bondaflex Sil 100 WF.
   i. Tremco Incorporated; Tremsil 200 Sanitary.

2. Applications:
   a. Tile control and expansion joints where indicated.
   b. Other joints as indicated.

3. Color: Selected by Architect from manufacturer’s full range of options.

2.7 JOINT SEALANT BACKING

A. General: Select and provide sealant backings of material as required to control the depth of sealant application, prevent three sided adhesions, and form hourglass shape necessary for proper joint function, and as follows:
   1. Nonstaining and compatible with joint substrates, sealants, primers, and other joint fillers.
   2. Approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: Provide type of backing material recommended by sealant manufacturer for sealant materials and joint applications for this Project.
   1. Closed-Cell Backer Rod: Non-gassing material, such as polyolefin, that does not permit vapor or air transmission between the cell structure.
   2. Open-Cell Backer Rod: Polyethylene or polyurethane foam that permits vapor or air transmission. Do not use with urethane or moisture-sensitive sealants, nor on horizontal joints.
   3. Dual-Cellular Backer Rod: ASTM C 1330, Type B (bicellular material with a surface skin).
   4. Sizes and Density: Minimum 25 percent larger and maximum 50 percent larger than the joint width, and as required to control sealant depth and otherwise contribute to producing optimum sealant performance.
      a. Provide 1/4-round and 1/2-round if required for fillet joints.
C. **Bond-Breaker Tape:** Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.
   1. Use where joints are not sufficiently deep for installing a cylindrical backer rod.
   2. **Sizing:** Precision fit tape to match joint sizes indicated. Select widths slightly wider than joint widths to allow for cutting and removal of excess tape.

### 2.8 MISCELLANEOUS MATERIALS

A. **Primer:** Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. **Cleaners for Nonporous Surfaces:** Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. **Masking Tape:** Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

D. **Cleaning Solvents:** As recommended by sealant manufacturer to be compatible with sealant and not adversely affect substrate.

E. **Cleaning cloths:** Clean, soft, absorbent, lint-free cloths, such as micro-fiber.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 MAINTENANCE OF EXISTING JOINT SEALANT

A. Inspect existing joints to be renovated. Verify the following:
   1. Joint sealants, backing, and other materials containing PCBs and other hazardous materials have been removed.
   2. Joint substrates and adjoining materials are structurally sound.
   3. Joints to be renovated can be satisfactorily repaired with specified methods and materials.

B. Report to Architect any condition that cannot be corrected as part of the specified renovation. Do not proceed until outstanding issues are resolved.

C. **Removal and Replacement:** For joints indicated, and further identified during pre-installation conference and inspection, remove existing joint sealants and backing.
   1. Do not remove silicone joints to be recapped and joints to be covered with silicone seals.
   2. Cut existing sealant close to joint edges.
   3. Clean joint with power or hand wire brush, grinding, saw cutting, or solvent cleaning to depth at which replacement backing and sealant are to be installed.
4. Blow out dust, loose particles, and debris with moisture and oil-free compressed air. Remove any pieces of caulk and backer rod lodged in joint.

5. Inspect substrates to receive replacement silicone sealant. Ensure surfaces are clean, dry, and free of frost, dust, and dirt.

6. Repair deteriorated or damaged substrates as recommended by silicone sealant manufacturer to provide suitable substrate for silicone seal. Allow patching materials to cure.

D. Recapping Silicone Sealant Joints: Clean existing silicone sealant that is sufficiently adhered and not mechanically damaged to prepare for recapping.
   1. Use two-cloth solvent wipe in accordance with ASTM C1193.
   2. Pour cleaning solvent onto clean cloth. Wipe vigorously to remove contaminants. Immediately wipe cleaned area with separate cloth before solvent has evaporated.

3.3 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
      a. Concrete.
      b. Masonry.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
      a. Metal.
      b. Glass.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.4 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
   4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
   5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.5 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Extent of Testing: Test completed and cured sealant joints as follows:
      a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
      b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
      a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   3. Inspect tested joints and report on the following:
      a. Whether sealants filled joint cavities and are free of voids.
      b. Whether sealant dimensions and configurations comply with specified requirements.
c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer’s field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.6 CLEANING
A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.7 PROTECTION
A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION
SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Standard hollow metal doors and frames.
2. Interior hollow metal framing.
3. Custom hollow metal frames.

B. Related Sections:
1. Section 087100 – Door Hardware.
2. Section 099113 – Exterior Painting.

1.2 REFERENCES

A. American National Standards Institute (ANSI)/Steel Door Institute (SDI)
2. A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
3. A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
5. A250.11 - Recommended Erection Instructions for Steel Frames.

B. ASTM International (ASTM)
1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
3. A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
4. E413 - Classification for Rating Sound Insulation.


1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

A. Consolidated Openings Submittal: Make submittal for Sections listed below in a single package. Include product data, shop drawings, and schedule data.
1. Section 081113 – Hollow Metal Doors and Frames.
2. Section 087100 – Door Hardware.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

C. Shop Drawings: Include the following:
   1. Elevations of each door design.
   2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, joints, field splices, and connections.
   7. Details of accessories.

D. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-(102-mm-) high wood blocking. Do not store in a manner that traps excess humidity. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: One of the following:
   1. Ceco Door Products.
2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
   1. Design: Flush panel.
   2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
      a. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) when tested according to ASTM C 1363.
         1) Locations: Exterior doors.
      a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
   4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
5. **Tolerances:** Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

**B. Exterior Doors:** Provide thermal-rated insulated-core doors, with face sheets fabricated from metallic-coated steel sheet; complying with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
   1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless), thermally broken, continuously welded seam dressed smooth.

**C. Hardware Reinforcement:** Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

**D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.**

### 2.4 STANDARD HOLLOW METAL FRAMES

**A. General:** Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

**B. Exterior Frames:** Fabricated from metallic-coated steel sheet.
   1. Fabricate frames with mitered or coped corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Frames for Level 3 Steel Doors: 0.053-inch (1.3-mm) thick steel sheet.
   4. Thermally Broken.

**C. Hardware Reinforcement:** Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

### 2.5 FRAME ANCHORS

**A. Jamb Anchors:**
   1. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch (9.5-mm) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

**B. Floor Anchors:** Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

### 2.6 STOPS AND MOLDINGS

**A. Fixed Frame Moldings:** Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

### 2.7 ACCESSORIES

**A. Ceiling Struts:** Minimum 1/4-inch-thick by 1-inch- (6.4-mm-thick by 25.4-mm-) wide steel.

**B. Grout Guards:** Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.
2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer’s plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:
   1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Fully Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
   4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
   5. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
      b. Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
         1) Three anchors per jamb.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section “Door Hardware.”
   1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
   2. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
2.9 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
   1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90-degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

D. Preparation of Existing Surfaces: Prepare existing surfaces and substrates exposed during demolition work as required to accommodate successive installation of new products specified in this Section.
   1. Reconstruct existing surfaces using methods and materials suitable for, and made ready to receive new work. Produce surfaces with levels, roughness textures, and at sizes and extents required to accommodate new materials.
   2. For new manufactured products, comply with manufacturer’s instructions for surface preparation.
   3. Provide primers, accessories, and other products and materials, as recommended by manufacturers of new products, and as required to complete the work.
4. Existing Materials: Use materials identical to existing materials to the greatest extent possible; or provide materials that are fully compatible with new materials.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable glazing stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Field apply bituminous coating to backs of frames that are filled with grout containing anti-freezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
   a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

3. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90-degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:
   a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION
SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Mechanical door hardware for the following:
         a. Swinging doors.

1.2 SUBMITTALS
   A. Product Data: For each type of product.
   B. Door hardware schedule.
   C. Keying schedule.
   D. Informational Submittals:
      1. Sample warranty.
   E. Closeout Submittals:
      1. Maintenance data.

1.3 QUALITY ASSURANCE
   A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by
      product manufacturers and of an Architectural Hardware Consultant who is available during the
      course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
      1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
   B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing
      consulting services for door hardware installations that are comparable in material, design, and
      extent to that indicated for this Project and who is currently certified by DHI as an Architectural
      Hardware Consultant (AHC).
   C. Preinstallation Meetings
      1. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY
   A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that
      fail in materials or workmanship within specified warranty period.
      1. Warranty Period: Three years from date of Substantial Completion unless otherwise
         indicated below:
         a. Exit Devices: Two years from date of Substantial Completion.
         b. Manual Closers: 10 years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design".

2.2 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
   1. Door hardware is scheduled in Part 3.

2.3 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
   1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.

C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

D. Lock Trim:
   1. Description: [As indicated on Drawings] <Insert description or manufacturer's design designation>.
   2. Levers: [Wrought] [Forged] [Cast].
      a. <Insert model number and description>.
   3. Escutcheons (Roses): [Wrought] [Forged] [Cast].
   4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
   1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
   2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: BHMA A156.2; [Grade 1] [Grade 2]; Series 4000.
G. Mortise Locks: BHMA A156.13; [Operational Grade 1] [Security Grade 1] [Operational Grade 2] [Security Grade 2]; stamped steel case with steel or brass parts; Series 1000.

2.5 AUXILIARY LOCKS
A. A156.36: [Grade 1] [Grade 2]; with strike that suits frame.
B. Mortise Auxiliary Locks: BHMA A156.36; [Grade 1] [Grade 2]; with strike that suits frame.
C. Narrow Stile Auxiliary Locks: BHMA A156.36; [Grade 1] [Grade 2]; with strike that suits frame.
D. Push-Button Combination Locks: BHMA A156.36; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.

2.6 LOCK CYLINDERS
A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. [Provide cylinder from same manufacturer of locking devices.]
B. Standard Lock Cylinders: BHMA A156.5; [Grade 1] [Grade 1A] [Grade 2] permanent cores; face finished to match lockset.
   1. Core Type: [Interchangeable]
D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.7 KEYING
A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. [Incorporate decisions made in keying conference.]
   a.
   2. Master Key System: Change keys and a master key operate cylinders.
      a. Provide three cylinder change keys and five master keys.
   3. Existing System:
      a. Master key or grand master key locks to Owner's existing system.
      b.
   4.
B. Keys: [Nickel silver] [Brass].
   1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
      a. Notation: "DO NOT DUPLICATE.".
2.8 OPERATING TRIM
   A. Operating Trim: BHMA A156.6; [aluminum] [brass] [bronze] [stainless steel] unless otherwise indicated.

2.9 OVERHEAD STOPS AND HOLDERS
   A. Overhead Stops and Holders: BHMA A156.8.

2.10 DOOR GASKETING
   A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
   B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:
      1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
      2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
      3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.11 THRESHOLDS
   A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.12 METAL PROTECTIVE TRIM UNITS
   A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050- (1.3-mm-) thick [aluminum] [brass] [bronze] [stainless steel]; with manufacturer's standard machine or self-tapping screw fasteners.

2.13 AUXILIARY DOOR HARDWARE
   A. Auxiliary Hardware: BHMA A156.16.

2.14 FINISHES
   A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Mounting Heights: Mount door hardware units at heights [indicated on Drawings] [to comply with the following] unless otherwise indicated or required to comply with governing regulations.
      2. Custom Steel Doors and Frames: HMMA 831.
      3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
   B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface
protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as [indicated in keying schedule] [directed by Owner].
   2. Furnish permanent cores to Owner for installation.

F. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, verify location with Architect.
   1. Configuration: Provide [one power supply for each door opening] [least number of power supplies required to adequately serve doors] with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
   1. Do not notch perimeter gasketing to install other surface-applied hardware.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 DOOR HARDWARE SCHEDULE

<table>
<thead>
<tr>
<th>HW SET: 1</th>
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<tbody>
<tr>
<td>EA HINGES</td>
</tr>
<tr>
<td>TA2314 NRP-S</td>
</tr>
<tr>
<td>MCK</td>
</tr>
<tr>
<td>1 EA STOREROOM LOCK</td>
</tr>
<tr>
<td>8204 J</td>
</tr>
<tr>
<td>SAR</td>
</tr>
<tr>
<td>1 EA LOCK GUARD</td>
</tr>
<tr>
<td>LG1</td>
</tr>
<tr>
<td>IVE</td>
</tr>
<tr>
<td>1 EA OH STOP</td>
</tr>
<tr>
<td>598H</td>
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<tr>
<td>SAR</td>
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<tr>
<td>Item</td>
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FUNCTION: L9080 (F07) Storeroom Lock
Latchbolt retracted by key outside or by lever inside. Outside lever always inoperative. Auxiliary latch deadlocks latchbolt when door is closed.

END OF SECTION
SECTION 096500
RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Resilient wall base.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Closeout Submittals:
   1. Maintenance Data: For each type of resilient wall base.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.
   1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.5 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.
B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 RESILIENT FLOORING

A. Resilient Flooring Products:
<table>
<thead>
<tr>
<th>ID</th>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB-1</td>
<td>Resilient Base</td>
<td>Johnsonite 4” High base, Profile: Cove Provide 5% extra stock.</td>
<td></td>
</tr>
</tbody>
</table>

B. Rubber Floor Base: Products complying with ASTM F1861, Type TS.
   1. Color: To be selected from Manufacturer’s full line of colors.
   2. Group: I (solid, homogeneous).
   3. Style and Location:
      a. Cove
   4. Minimum Thickness: 0.125 inch (3.2 mm).
   5. Height: 4 inches (102 mm).
   8. Inside Corners: Mitre and Butt

C. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
   1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Rubber Floor Adhesives: Not more than 60 g/L.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
      b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 WALL BASE INSTALLATION

A. Apply adhesive continuously to back of base.

B. Maintain top edge true to line and bottom edge in continuous contact with floor. Butt joints tight; butt base tight to adjacent construction.

C. Do not install pieces less than 6-inches long.

D. Miter and butt inside corners.

E. At outside corners install preformed corner pieces.

F. At exposed ends, install premolded units.

G. Scribe to door frames and other interruptions.

3.3 CLEANING AND PROTECTION

A. Protect resilient base from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY
A. Section includes resinous flooring systems.
B. Related Sections:
   1. Section

1.2 SUBMITTALS
A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
B. Samples for Initial Selection: For each type of exposed finish required.
C. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
D. Informational Submittals:
   1. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
   2. Material Certificates: For each resinous flooring component, from manufacturer.
   3. Material Test Reports: For each resinous flooring system, by a qualified testing agency.
E. Closeout Submittals:
   1. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.3 QUALITY ASSURANCE
A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
C. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.5 FIELD CONDITIONS
A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

1.6 WARRANTY

A. Installer to provide a single source one (1) year warranty for applications and materials from manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flammability: Self-extinguishing according to ASTM D 635.

2.2 MANUFACTURERS

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

B. Acceptable Manufacturers and Products:
   2. Key Resin, comparable product.
   3. Tennant Company, comparable product.
   4. Stonhard, comparable product.
   6. Tnemec, StrataShield, comparable product.
   7. Florock Polymer Flooring, comparable product.

2.3 RESINOUS FLOORING

A. Resinous Flooring System: Epoxy-based multi-roller applied flooring system with Q28 or Q11 colored quartz aggregate and urethane topcoat.
   1. Colors and Patterns:

<table>
<thead>
<tr>
<th>ID</th>
<th>PRODUCT</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>EREZ-1</td>
<td>Colors and texture to match existing.</td>
<td>Corridor 1226A</td>
</tr>
</tbody>
</table>

   2. Wearing Surface: Manufacturer's standard slip-resistant wearing surface.
   3. Overall System Thickness: 1/8 inch (3.2 mm).

B. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
   1. Formulation Description: 100 percent solids.

C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
D. Body Coats:
   1. Resin: Epoxy.
   2. Formulation Description: 100 percent solids.
   3. Application Method: Troweled or screeded.
   4. Number of Coats: One.
   5. Thickness of Coats: 1/8 inch (3.2 mm).
   6. Aggregates: Colored quartz (ceramic-coated silica).

E. Grout Coat:
   1. Resin: Epoxy.
   2. Formulation Description: 100 percent solids.
   3. Thickness of Coat: 1/8 inch (3.2 mm).

F. Topcoats: Sealing or finish coats.
   1. Resin: Urethane.
   2. Formulation Description: 100 percent solids.
   3. Type: Clear.
   4. Number of Coats: One.
   5. Thickness of Coats: 1/8 inch (3.2 mm).

G. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
   1. Compressive Strength: 12,500 psi minimum according to ASTM C 579.
   2. Tensile Strength: 2,600 psi minimum according to ASTM C 307.
   3. Flexural Modulus of Elasticity: \(6.2 \times 10^5\) per ASTM D 790.
   4. Water Absorption: 0.04 percent maximum according to ASTM C 413, or D 570.
   5. Indentation: 0.025 percent maximum according to MIL-D-3134J.
   6. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation according to MIL-D-3134J.
   7. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) according to MIL-D-3134J.
   8. Abrasion Resistance: 24 mg loss maximum weight loss according to ASTM D 4060.
   9. Hardness: 75-80, Shore D according to ASTM D 2240.
   10. Critical Radiant Flux: 0.45 W/sq. cm or greater according to NFPA 253.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer’s written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
   1. Roughen concrete substrates as follows:
3.2 APPLICATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
   2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
   3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Troweled or Screeed Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.

D. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.

E. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.
3.3 FIELD QUALITY CONTROL

A. Material Sampling: Owner may, at any time and any number of times during resinous flooring application, require material samples for testing for compliance with requirements.
   1. Owner may engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
   3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

B. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per 1000 sq. ft. (92.9 sq. m) of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

3.4 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION
SECTION 096800
CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Modular carpet tile.

B. Related Sections:
   1. Section 142400 – Hydraulic Elevators, For elevator floor.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. Informational Submittals:
   1. Qualification Data: For Installer.
   2. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Closeout Submittals:
   1. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
      a. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
      b. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

D. Maintenance Material Submittals: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Carpet Tile: Full-size units equal to 100-percent of amount indicated.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI Carpet Installation Standard.
1.5 PROJECT CONDITIONS

A. Comply with CRI Carpet Installation Standard.

B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.6 WARRANTY

A. Special Warranty for Carpet: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.

2. Failures include, but are not limited to, more than 10-percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.

3. Warranty Period: Lifetime of product.

4. Wear: Lifetime of Carpet, no more than 10-percent face yarn loss by weight in normal use.

5. Edge Ravel: Lifetime of Carpet

6. Delamination: Lifetime of Carpet. No delamination in normal use. Chair pads not required but are recommended for maximum texture retention.


8. Stain Resistance: Lifetime stain warranty and a 10-year lightfastness and atmospheric contaminant warranty on products with Duracolor.

PART 2 - PRODUCTS

2.1 CARPETING

A. Carpet Tile, General: Specified products are in compliance with testing and product requirements of CRI’s “Green Label Plus” program.

1. Thickness: 1/4 inch.

B. Carpet Products:

<table>
<thead>
<tr>
<th>ID</th>
<th>TYPE</th>
<th>PRODUCT</th>
<th>LOCATION</th>
</tr>
</thead>
</table>
| CPT-1 | Carpet – Walk-off Tile | Manufacturer: J+J Flooring Group  
Style: Runway II Walkoff  
Color: False Eyelashes  
Mannington Commercial – Comparable Product  
Mohawk – Comparable Product  
Patcraft – Comparable Product | Elevator |
2.2 INSTALLATION ACCESSORIES

A. Underlayments and Patching Compound: Trowelable, latex-modified, portland cement-based formulation provided or approved by manufacturer of flooring materials for installations indicated; and that can be feathered at edges to match adjacent floor elevations. Provide manufacturer’s primer and accessory product required to suit conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet for type, color, pattern, and potential defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI Carpet Installation Standard, and with carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Preparation of Existing Surfaces: Prepare existing surfaces and substrates exposed during demolition work as required to accommodate successive installation of new materials specified in this Section.

1. Reconstruct existing surfaces using methods and materials suitable for, and made ready to receive new work. Produce surfaces with levels, roughness textures, and at sizes and extents required to accommodate new materials.

2. For new manufactured products, comply with manufacturer’s instructions for surface preparation.

3. Provide primers, accessories, and other products and materials, as recommended by manufacturers of new products, and as required to complete the work.

4. Existing Materials: Use materials identical to existing materials to the greatest extent possible; or provide materials that are fully compatible with new materials.

C. Use trowelable leveling and patching compounds, according to manufacturer’s written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

D. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

E. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

F. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.
3.3 **CARPET TILE INSTALLATION**

A. General: Comply with CRI Carpet Installation Standard, and with carpet manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 **CLEANING AND PROTECTION**

A. Perform the following operations immediately after installing carpeting:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.

B. General: Comply with CRI Carpet Installation Standard, and with carpet manufacturer's written installation instructions.

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Exterior painting.

B. Related Sections:
   1. Section 034500 – Architectural Precast Concrete.
   2. Section 081113 – Hollow Metal Doors and frames.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Samples for Initial Selection: For each type of topcoat product indicated.
C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
   1. Submit Samples on rigid backing, 8 inches (200 mm) square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.
D. Product List: For each product indicated, include the following:
   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
E. Closeout Submittals:
   1. Maintenance Materials (Attic Stock):
      a. Paint: 1 gal. (3.8 L) of each material and color applied.

1.3 QUALITY ASSURANCE

A. MPI Standards: Where MPI designations are specified, comply with MPI standards listed in "MPI Approved Products List."
   1. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
   2. Gloss and sheen levels shall be as established according to MPI standard designations.
B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Apply benchmark samples after permanent lighting and other environmental services have been activated.

3. Final approval of color selections will be based on benchmark samples.
   a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.5 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
   B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Gloss and Sheen Standards: As follows, based on MPI, as follows:

<table>
<thead>
<tr>
<th>Gloss Level</th>
<th>Description</th>
<th>Gloss at 60 degrees</th>
<th>Sheen at 85 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloss Level 1</td>
<td>a traditional matte finish - flat</td>
<td>max 5 units</td>
<td>and max 10 units</td>
</tr>
<tr>
<td>Gloss Level 2</td>
<td>a high side sheen flat - a 'velvet-like' finish</td>
<td>max 10 units</td>
<td>and 10-35 units</td>
</tr>
<tr>
<td>Gloss Level 3</td>
<td>a traditional 'eggshell-like' finish</td>
<td>10-25 units</td>
<td>and 10-35 units</td>
</tr>
<tr>
<td>Gloss Level 4</td>
<td>a 'satin-like' finish</td>
<td>20-35 units</td>
<td>and min 35 units</td>
</tr>
<tr>
<td>Gloss Level 5</td>
<td>a traditional semi-gloss</td>
<td>35-70 units</td>
<td></td>
</tr>
<tr>
<td>Gloss Level 6</td>
<td>a traditional gloss</td>
<td>70-85 units</td>
<td></td>
</tr>
<tr>
<td>Gloss Level 7</td>
<td>a high gloss</td>
<td>more than 85 units</td>
<td></td>
</tr>
</tbody>
</table>

2.2 EXTERIOR PAINTS

A. Exterior Acrylic Paint: Water-based, exterior, 100 percent acrylic, alkali resistant, latex paint.
   1. Acceptable Product: One of the following:
      a. Benjamin Moore, Aura 629.
      b. Sherwin Williams, A-100.
c. Hirshfield's, Housecoat.
d. Glidden Professional, Fortis 450.
e. Diamond Vogel, Permacryl Exterior Acrylic.


B. **PTXM-1**: Exterior Light Industrial Coating: Water based, pigmented, emulsion coating for exterior primed metal surfaces providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions:

1. Acceptable Product: One of the following:
   c. Sherwin Williams, Pro Industrial, DTM Semi-gloss, B66W01151.

2. Gloss Level: 5.

3. Color: Selected by Architect from manufacturer's full range of custom options.

### 2.3 PAINT COLORS

A. General: Match paint colors for the following, by matching actual paint brands and models, or by another acceptable manufacturer's paints matching colors indicated using computerized color matching systems.

B. Paint Color Schedule: Match paint colors based on the following:

   **PTXL-1** Sherwin Williams, to match existing colors and sheens.

#### PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

   1. Masonry: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
   2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
   1. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.
3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Precast Concrete:
   2. Finish coats: 2-coats exterior 100 percent acrylic.

B. Hollow metal doors and frames:
   1. Finish Coats: 2 coats specified light-industrial exterior coating.

END OF SECTION
SECTION 099123
INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior painting.

B. Related Sections:
   1. Section 042000 – Unit Masonry.
   2. Section 055000 – Metal Fabrications.
   3. Section 081113 – Hollow Metal Doors and Frames.

1.2 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.
   1. Material List: Provide inclusive list of required coating materials. Indicate each material
      and cross-reference specific coating, finish system, and application. Identify each
      material by manufacturer's catalog number and general classification.
   2. Manufacturer's Information: Provide manufacturer's technical information, including label
      analysis and instructions for handling, storing and applying each coating material
      proposed for use.
   3. Certification by manufacturer that products supplied comply with local regulations
      controlling use of volatile organic compounds (VOCs).

B. Samples: Submit paint and transparent finish samples, for color selection and finish
   acceptance.
   1. Paint Colors, Surface Treatments and Finishes: As selected by Architect. Submit three 4
      inch by 6 inch samples to be reviewed for color and sheen. Architect reserves right to
      select color or finish from any manufacturer, herein specified, as necessary to achieve
      desired color or finish.

C. Schedule: For acceptance, submit 3 copies of complete schedule showing each product by
   number and brand name proposed to be used at each surface and location. Generally, follow
   specified outline and list number of coats.

D. Closeout Submittals:
   1. Maintenance Materials (Attic Stock): Furnish extra paint materials from the same
      production run as the materials applied and in the quantities described below. Package
      with protective covering for storage and identify with labels describing contents. Deliver
      extra materials to Owner.
      a. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
         1) Interior, Paint: 1 gal. of each color applied.
         2) Exterior, Paint: 1 gal. of each color applied.
1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by same manufacturer as finish coats.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

C. Applicator Qualifications: Engage experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with record of successful in-service performance.

D. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
      b. Other Items: Architect will designate items or areas required.
   2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
   3. Final approval of color selections will be based on benchmark samples.
      a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 PROJECT CONDITIONS

A. Environmental Requirements: Comply with manufacturer's recommendations as to environmental conditions under which painting and finishing can be applied. Do not apply finish in areas where dust is being generated.

B. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture contents of surfaces are below following maximums:
   1. Masonry, Concrete and Concrete Block: 12-percent.

C. Ensure surface temperature and surrounding air temperature is above 40 degrees F before applying finishes. Minimum application temperature for latex paints for interior work shall be 45 degrees F and 50 degrees F for exterior work. Minimum application temperature for transparent finish shall be 65 degrees F, or surface and air temperature shall be 5 degrees above dew point.

D. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 45 degrees F for 24 hours before, during and 48 hours after application of finishes.

E. Provide minimum 25 foot candles of lighting on surfaces to be finished.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver paint materials in sealed original labeled containers, bearing manufacturer's name, type of paint, brand name, color designation and instructions for mixing or reducing.
B. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45 degrees F in well-ventilated area. Restrict storage to paint materials and related equipment.

C. Take precautionary measures to prevent fire hazards and spontaneous combustion. Comply with health and fire regulations.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

C. Gloss and Sheen Standards: As follows, based on MPI, as follows:

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2.2 INTERIOR PRIMERS

A. Interior Block Filler: Water based, high solids, emulsion type pigmented coating, with bridging and filling properties, for interior or exterior concrete masonry units, for the purpose of filling the surface for subsequent applications of paint.

1. Acceptable Products: One of the following
   a. Benjamin Moore, Ultra Spec, Int/Ext High-Build Masonry Block Filler.
   b. PPG Paints, Speedhide Int/Ext Masonry Block Filler 6-7
   c. Sherwin Williams, Prep-Rite, Int/Ext Block Filler.
   d. Hirschfield’s, Prowall 4000 Block Filler.
   e. Diamond Vogel, Dia Pro Acrylic Block Filler.

2. VOC Limit: 50 g/L or less.

B. Interior Concrete Primer: Water based, alkali resistant, pigmented primer used on alkaline surfaces such as plaster, vertical concrete and masonry surfaces.

1. Acceptable Products: One of the following
   a. Benjamin Moore, Ultra Spec, Masonry Int/Ext 100 Acrylic Sealer.
   b. PPG Paints, Perma-Crete Int/Ext Alkali Resistant Primer 4-603.
   c. Sherwin Williams, Loxon, Concrete & Masonry Primer.
d. Hirschfield’s, AMP Acrylic Masonry Primer. 4050.
e. Diamond Vogel, OmniPrep Universal Interior Primer.

2. VOC Limit: 50 g/L or less.

C. Interior Latex Primer/Sealer, Low-Odor / Low-VOC: White pigmented, water based primer sealer with low odor characteristics and VOC of less than 10 grams per liter.

1. Acceptable Products: One of the following:
   b. PPG Paints, Speedhide Zero VOC Interior Primer 6-4900XI
   c. Sherwin Williams, ProMar 200 Zero.
   d. Hirschfield’s, Contractor Select 88-1270 series.
   e. Diamond Vogel, Health Kote Interior Zero VOC Primer.

2. VOC Limit: 50 g/L or less.

D. Interior Latex Primer, Stain Blocking: Water based, pigmented primer and stain sealer.

1. Acceptable Products: One of the following
   a. Benjamin Moore, Fresh Start High Hiding Primer.
   b. PPG Paints, Seal GripAcrylic Primer 17-921
   c. Sherwin Williams, Preprite Problock.
   d. Diamond Vogel, OmniPrep Universal Interior Primer.

2. VOC Limit: 100 g/L or less.

2.3 INTERIOR PAINTS

A. Interior Latex, Institutional Low Odor/Low VOC: Water-based, 100 percent acrylic latex paint.

1. Acceptable Products: One of the following, and compatible with primers indicated.
   a. Benjamin Moore, Ultra Spec 500.
   b. Sherwin Williams, ProMar 200.
   c. PPG Paints, Speedhide Zero VOC Eggshell 6-4310XI
   d. Hirschfield’s, Reserve, 100% Acrylic.
   e. Diamond Vogel, Zero Plus 0 VOC Interior Latex Eggshell.

2. Gloss Level 3.

3. VOC Limit: 50 g/L or less.

B. Interior Latex, Light Industrial Coating: Water based, pigmented, acrylic emulsion coating for interior primed metal surfaces providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions and a VOC of less than 250-grams per liter.

1. Acceptable Products: One of the following
   a. Benjamin Moore, Ultra Spec HP DTM.
   b. Sherwin Williams, Pro Industrial DTM.
   d. Hirschfield’s, Acrylic DTM Coating, 9590 series.

2. Gloss Level: 5.
3. VOC Limit: 150 g/L or less.
C. Deliver paints ready-mixed to job site.
D. Job mixing and job tinting is not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine surfaces to receive paint and transparent finishes for conditions that would adversely affect execution, permanence or quality of work and which cannot be put into acceptable condition through preparatory work. Do not proceed with surface preparation or coating application until conditions are suitable.

3.2 PREPARATION OF SURFACES
A. Perform preparation and cleaning procedures in accordance with paint manufacturer’s instructions and as specified, for each particular substrate condition.
   1. Remove mildew, by scrubbing with solution of detergent, bleach and warm water. Rinse with clean water and allow surface to dry completely.
   2. Remove surface contamination from aluminum surfaces requiring paint finish by steam, high pressure water or solvent washing. Apply etching primer or acid etch. Apply paint immediately if acid etching.
   3. Remove contamination from copper surfaces requiring paint finish by steam, high pressure water or solvent washing. Apply vinyl etch primer or acid etch. Apply paint immediately if acid etching.
   4. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of anticipated problems in using specified coating systems with substrate primed by others.
B. Remove hardware, hardware accessories, plates, lighting fixtures, and similar items in-place and not to be finish painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items by workmen skilled in trades involved.
C. Clean surfaces to be painted before applying paint or surface treatment. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program cleaning and painting so that dust and other contaminants from cleaning process will not fall in wet, newly painted surfaces.
   1. Remove dirt, oil, grease and sand if necessary to provide adhesion key, when asphalt, creosote or bituminous surfaces require paint finish. Apply compatible sealer or primer.
   2. Remove dirt, grease and oil from canvas and cotton insulated coverings.
D. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block and cement plaster to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint.
   1. Remove contamination, acid etch and rinse new concrete floors with clear water. Ensure required acid alkali balance is achieved. Allow to thoroughly dry. Repeat procedure if necessary to achieve a medium sandpaper-like profile.
2. Remove dirt, loose mortar, scale, powder and other foreign matter from concrete and concrete block surfaces which are to be painted or to receive clear seal. Remove oil and grease with solution of trisodium phosphate, rinse well and allow to thoroughly dry.

3. Remove stains from concrete and concrete block surfaces caused by weathering of corroding metals with solution of sodium metasilicate after being thoroughly wetted with water. Allow to thoroughly dry.

E. Galvanized Surfaces: Clean free of oil and surface contaminates with acceptable non-petroleum based solvent.

F. Ferrous Metals: Clean non-galvanized, ferrous surfaces that have not been shop-coated of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning, complying with Steel Structures Painting Council (SSPC)-SP3.

1. Touch-up shop-applied prime coats which have damaged or bare areas. Wire-brush, solvent-clean, and touch-up with same primer as shop coat.

2. Clean unprimed steel surfaces by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned. Prime surfaces to indicate defects, if any. Paint after defects have been remedied.

3. Sand and scrape shop primed steel surfaces to remove loose primer and rust. Feather out edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. (Prime steel including shop primed steels.)

3.3 MATERIALS PREPARATION

A. Mix and prepare painting materials and transparent finish materials in accordance with manufacturer's directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in clean condition, free of foreign materials and residue.

C. Stir materials before application to produce mixture of uniform density, and as required during application of materials. Do not stir any film that may form on surface into material. Remove film and, if necessary, strain material before using.

3.4 APPLICATION

A. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.

2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

4. Apply each coat at proper consistency.

5. Each coat of paint shall be slightly darker than preceding coat unless otherwise approved by Architect.

6. Provide finish coats which are compatible with prime paints used.

B. Do not apply succeeding coats until previous coat has completely dried. Sand between each enamel or varnish coat application with fine sandpaper, or rub surfaces with pumice stone.
where required to produce even, smooth surface in accordance with coating manufacturer's directions.

1. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by manufacturer.

C. 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. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive film thickness equivalent to that of flat surfaces.

D. Finish doors on tops, bottoms, and side edges same as exterior faces, unless otherwise indicated.

E. Film Thickness: Apply materials in accordance to paint manufacturer’s recommendations and spreading rates to provide total dry film thickness as recommended.
   1. Apply paint materials no thinner than manufacturer’s recommended spreading rate to achieve dry film thickness indicated
   2. Use precision instruments designed for measuring and evaluation wet and dry films of paints and coatings.
   3. Results measuring less than recommended thickness will require additional material application.
   4. Use of poor hiding colors may require application of additional coats in order to achieve proper coverage and hiding.

F. Apply first-coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

G. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of undercoat.

H. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure finish coat with no burn-through or other defects due to insufficient sealing.

I. Paint surfaces behind movable equipment or furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 MECHANICAL AND ELECTRICAL EQUIPMENT

A. Refer to mechanical and electrical documents with respect to field painting and finishing requirements. Painting of mechanical and electrical work is not required in pipe chases, tunnels, and mechanical rooms with unpainted walls.

B. Remove grilles, covers and access panels for mechanical and electrical systems from location and paint separately.

C. Finish paint primed equipment to color selected.

D. Paint exposed piping, insulated piping and conduit occurring in finished areas. Color and texture to match adjacent surfaces.
3.6 CLEANING
A. As work proceeds and upon completion, promptly remove paint where spilled, splashed or spattered. Touch up and restore damaged or defaced painted areas.
B. During progress of work keep premises free from unnecessary accumulation of tools, equipment, surplus materials and debris. Remove at end of each workday.
C. Upon completion of work clean window glass and other paint-spattered surfaces and leave premises neat and clean, to satisfaction of Architect.

3.7 PROTECTION
A. Adequately cover or otherwise protect finished work of other trades and other surfaces from paint and damage. Repair damage as result of inadequate or unsuitable protection as acceptable to Architect.
   1. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.
B. Place cotton waste, cloths and material which may constitute fire hazard in closed metal containers and remove daily from site.
C. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items shall be carefully stored, cleaned and replaced on completion of work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.
D. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.8 PAINT COLOR AND SHEEN SCHEDULE
A. General: Match paint colors for the following, by matching actual paint brands and models, or by another acceptable manufacturer’s paints matching colors indicated using computerized color matching systems.
B. Paint Color and Sheen Schedule:

<table>
<thead>
<tr>
<th>ID</th>
<th>PRODUCT</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT-1</td>
<td>To match adjacent existing colors and patterns</td>
<td></td>
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</tbody>
</table>

3.9 INTERIOR PAINTING SCHEDULE
A. CMU Substrates, Latex:
B. Concrete Substrates, Nontraffic Surfaces:
   1. Prime Coat: Interior concrete primer.

C. Interior Steel Doors and Frames, and Interior Steel Fabrications:
   1. Primer: Shop primed specified in other Sections:
      a. 055000 – Metal Fabrications.
      b. 055100 – Metal Stairs.
      c. 081113 – Hollow Metal Doors and Frames
      d. 083113 – Access Doors and Frames
   3. Top Coat: Interior latex light industrial coating, gloss level 5

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hydraulic passenger and service elevators.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
4. Section 055000 "Metal Fabrications" for the following:
   a. Attachment plates and angle brackets for supporting guide-rail brackets.
   b. Hoist beams.
   c. Structural-steel shapes for subsills.
   d. Pit ladders.
   e. Cants in hoistways made from steel sheet.
5. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
6. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
7. Section 283111 "Digital, Addressable Fire-Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation and for connection to elevator controllers.

1.2 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.3 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station and standby power operation control panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Informational Submittals:

1. Qualification Data: For Installer.
2. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical
service including standby power generator, as shown and specified, are adequate for elevator system being provided.


D. Closeout Submittals:
   1. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
      a. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
   2. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

1.4 QUALITY ASSURANCE
A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.6 COORDINATION
A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
B. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.7 WARRANTY
A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
   2. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
2.2 HYDRAULIC ELEVATORS

A. Hydraulic Elevators: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.
   2. Otis – Comparable Product
   3. Schindler – Comparable Product

B. Source Limitations: Obtain elevators from single manufacturer.
   1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

C. ELEVATOR-1: Passenger Elevator Description:
   1. Type: Holeless, Single stage, beside-the-car, telescoping, dual cylinder.
   2. Power: 480 V.
   4. Freight Loading Class for Service Elevators: Class A.
   5. Rated Speed: 150 fpm (0.76 m/s).
   7. Auxiliary Operations:
      a. Standby power operation.
   8. Hoistway Entrances: Center Opening 7'-0" x 3'-6" doors
   9. Car Enclosures:
      a. Car Fixtures: Satin stainless steel, No. 4 finish.
      b. Side and Rear Wall Panels: Plastic laminate selected from Manufacturer's standard patterns.
      c. Reveals: Satin stainless steel, No. 4 finish.
      d. Door Faces: Satin stainless steel, No. 4 finish.
      e. Door Sills: Nickel silver.
      f. Ceiling: Suspended with LED lighting above and occupancy sensor.
      g. Handrails: 1-1/2-round, Satin stainless steel, No. 4 finish.
      h. Floor finish: Carpet tile as specified in Section 096800 – Carpeting.
   10. Additional Requirements:
       a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
       b. Provide hooks for protective pads and complete set(s) of full-height protective pads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

D. Install piping above the floor, where possible. Install underground piping in casing.

E. Lubricate operating parts of systems as recommended by manufacturers.

F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

G. Leveling Tolerance: 1/4-inch (6 mm), up or down, regardless of load and travel direction.

H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

I. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
   1. Place hall lanterns either above or beside each hoistway entrance.
   2. Mount hall lanterns at a minimum of 72-inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for elevator used for construction purposes:
   1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
   2. Provide strippable protective film on entrance and car doors and frames.
   3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).
B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer’s authorized replacement parts and supplies.
   1. Perform maintenance during normal working hours.
   2. Perform emergency callback service during normal working hours with response time of two hours or less.
   3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of two hours or less.

   END OF SECTION
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. The requirements contained in the latest version of Enterprise Green Communities Criteria apply to project.

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Sleeves.
   3. Escutcheons.
   5. Equipment installation requirements common to equipment sections.
   6. Concrete bases.
   7. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, space above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. PE: Polyethylene plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment, Plumbing Equipment and HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression, plumbing, and mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

D. The domestic water piping system is based on copper. All domestic water pipe sizing is based on copper. Although alternate piping materials are allowed as per code, any system redesign resulting from the selection of an alternate material is incumbent on the contractor to perform. Any redesigned system shall be submitted to the authority having jurisdiction for review and approval. Modifications and resubmittals will be by the contractor. The signing engineer will be copied for review.

E. The contractor is responsible for any design and or document resubmittals to the Authority Having Jurisdiction due to contractor initiated changes. Any redesign shall be by the contractor. Changes shall be submitted to the Engineer for review prior to resubmission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.
2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 300-psig minimum working pressure as required to suit system pressures.
1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.

2.5 SLEEVES

A. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

B. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.
2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

D. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings. Not all pipe fittings, valves and appurtenances may be shown but are nonetheless still required to be included by the contractor.

C. Coordination Drawings: Using 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. Any and all other systems installed in same space as ducts.
   3. Ceiling- and wall-mounting access doors and panels required to provide access to valves, dampers and other operating devices.
   4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, fire sprinklers, access panels, and special moldings.

D. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping in exposed locations and in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Ensure piping is installed as tightly to the structure as possible.

F. Install approved expansion joints in all non-ferrous piping as per code and as per the manufacturer’s recommendation.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
H. Install piping to permit valve servicing.

I. Install piping at indicated slopes.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install piping to allow application of insulation.

M. Install piping as per code with the appropriate puncture prevention plates. Arrange PEX tubing so as not to lay against the finished dry wall or plaster in the areas between studs, joists and beams.

N. Select system components with pressure rating equal to or greater than system operating pressure.

O. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

P. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

T. Provide dielectric union at all dissimilar metal piping and equipment connections.

U. Provide condensate piping extending from all plumbing/mechanical equipment that produces condensate. Direct flow to an approved discharge location.

V. All plastic pipe, fittings and components shall be third party certified as conforming to NSF 14.

W. Sanitary waste, vent, storm and waste fixtures shall be either third-party certified or third-party tested.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 6 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT AND PIPING INSTALLATION - COMMON REQUIREMENTS

A. Install equipment and piping to allow maximum possible headroom.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Ensure all Plumbing equipment is set providing the manufactures minimum service and intake/exhaust air clearance requirements. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 ERECTION OF METAL SUPPORTS, CLAMPS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports, clamps, and anchors accurately in location, alignment, and elevation to support, clamp, and anchor plumbing and fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical systems materials and equipment.
B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. 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 the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.8 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 PERMITTING

A. Contractor shall pay for gas, sanitary, storm, water connection and all other required connection charges.

END OF SECTION 220500
SECTION 220513
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

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. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 7500 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium Energy efficient.

C. Service Factor: 1.15.

D. Rotor: Random-wound, squirrel cage.

E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating.
G. Insulation: Class F.

H. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.

B. Efficiency: Premium Efficiency.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513
SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

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 general-duty valves:
   1. Bronze ball valves.
   2. Ferrous-alloy butterfly valves.

B. Related Sections include the following:
   1. Division 22 Sections for general-duty and specialty valves for site construction piping.
   2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and charts.
   3. Division 22 Sections for specialty valves applicable to those Sections only.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure.
   2. PTFE: Polytetrafluoroethylene plastic.
   3. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   4. Set butterfly valves closed or slightly open.
   5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL
A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2-1/2 and smaller with threaded ends; NPS 3 with flanged ends.

C. Ferrous Valves: NPS 4 and larger with flanged ends.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
   1. Lever Handle: For quarter-turn valves.

G. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.


I. Valve Grooved Ends: AWWA C606.
   1. Solder Joint: With sockets according to ASME B16.18.
      a. Caution: Use solder with melting point below 840 deg F for check valves; below 421 deg F for ball valves.
   2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
   1. Manufacturers: Subject to compliance with requirements:
      a. American Valve, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Hammond Valve.
      e. Milwaukee Valve Company.
      f. NIBCO INC.
      g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   2. Description:
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded or Flanged
      g. Ends: Soldered ends may be used for 3/4 NPS and less.
      h. Seats: PTFE or TFE.
      i. Stem: Bronze.
      j. Ball: Chrome-plated brass.
      k. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements:
      a. American Valve, Inc.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

3.3 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Common Work Results " for basic piping joint construction.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
3.4 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523
SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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 plumbing system piping and equipment:
1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.

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 QUALITY ASSURANCE


B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.3, "Structural Welding Code--Sheet Steel."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

PART 2 - PRODUCTS

2.1 STEEL 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. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

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. Mechanical-Expansion Anchors: Insert-wedge-type stainless 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:
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head.
      e. MKT Fastening, LLC.
      f. Powers Fasteners.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Manufacturers:
   2. HOLDRITE Corp.; Hubbard Enterprises.
   3. Samco Stamping, Inc.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, steel plates, shapes, and bars; black and galvanized.

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. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. 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): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. **Steel Clevises (MSS Type 14):** For 120 to 450 deg F piping installations.
2. **Steel Weldless Eye Nuts (MSS Type 17):** For 120 to 450 deg F piping installations.

**H. Building Attachments:** Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. **Side-Beam Brackets (MSS Type 34):** For sides of steel or wooden beams.
2. **Horizontal Travelers (MSS Type 58):** For supporting piping systems subject to linear horizontal movement where headroom is limited.

**I. Saddles and Shields:** Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. **Thermal-Hanger Shield Inserts:** For supporting insulated pipe.

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

**K.** Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

**L.** Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

**M.** Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

### 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.** **Trapeze Pipe Hanger Installation:** Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. **Pipes of Various Sizes:** Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. **Field fabricate from ASTM A 36, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.**

**C.** **Thermal-Hanger Shield Installation:** Install in pipe hanger or shield for insulated piping.

**D.** **Fastener System Installation:**
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

**E.** **Pipe Positioning System Installation:** Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 15 Section "Plumbing Fixtures" for plumbing fixtures.

**F.** Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

**G.** **Equipment Support Installation:** Fabricate from welded-structural-steel shapes.
H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   4. Insert Material: Length at least as long as protective shield.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 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 1-1/2 inches.

3.5 PAINTING

A. Touch Up: 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 220529
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. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Housed spring mounts.
5. Elastomeric hangers.
7. Spring hangers with vertical-limit stops.
8. Pipe riser resilient supports.
9. Resilient pipe guides.
10. Seismic snubbers.
11. Restraining braces and cables.

1.3 DEFINITIONS

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: C

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For testing agency.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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:

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
4. Isolation Technology, Inc.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.

D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
F. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

G. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

H. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

I. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

J. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

K. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

L. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

M. Pipe Riser Resilient Support <Insert drawing designation>: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES
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:

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
5. Mason Industries.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

D. **Steel Base:** Factory-fabricated, welded, structural-steel bases and rails.
   1. **Design Requirements:** Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.
   2. **Structural Steel:** Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
   3. **Support Brackets:** Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

E. **Inertia Base:** Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
   1. **Design Requirements:** Lowest possible mounting height with not less than 1-inch above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.
   2. **Structural Steel:** Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
   3. **Support Brackets:** Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
   4. **Fabrication:** Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 **SEISMIC-RESTRAINT DEVICES**

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:

B. **Managers:** Subject to compliance with requirements, provide products by one of the following:

C. **Basis-of-Design Product:** Subject to compliance with requirements, provide a comparable product by one of the following:
   1. Amber/Booth Company, Inc.
   2. California Dynamics Corporation.
   3. Cooper B-Line, Inc.; a division of Cooper Industries.
   4. Hilti, Inc.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.

F. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

G. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

H. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

I. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

J. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

K. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

L. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

M. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
   3. Baked enamel or powder coat for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
   1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
   3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction[ providing required submittals for component.

B. Piping Restraints:
1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.
C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days’ advance notice.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
11. Test and adjust air-mounting system controls and safeties.
12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548
SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
   2. Pipe labels.
   3. Valve tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
   B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
   C. Valve numbering scheme.
   D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 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, 1/8 inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.
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 identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. 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 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: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link, beaded chain 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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:
   1. Domestic Water Piping:
      b. Letter Color: Black.
   2. Sanitary Waste and Storm Drainage Piping:
      b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, system branch piping isolation/service valves, shut-off valves, balancing valves, check valves, plumbing riser valves, equipment isolation valves. Valve tags not required: valves within factory-fabricated equipment units, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
   2. Valve-Tag Color:
      c. Recirculating Hot Water: White
   3. Letter Color:
      b. Hot Water: Black.
      c. Recirculating Hot Water: Black

END OF SECTION 220553
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. Section Includes:
   1. Insulation Materials:
      a. Flexible elastomeric.
      b. Mineral fiber.
   2. Adhesives.
   3. Sealants.
   4. Factory-applied jackets.
   5. Tapes.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. 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.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. 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, 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.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products:
      a. Armacell LLC; AP Armaflex.
      b. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products:
      a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000 Pipe Insulation.
c. Manson Insulation Inc.; Alley-K.
d. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin.
   Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Board Insulation: Mineral or glass fibers bonded with a thermosetting resin.
   Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products:
   a. Johns Manville; MicroFlex.
   b. Knauf Insulation; Pipe and Tank Insulation.
   c. Manson Insulation Inc.; AK Flex.
   d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.3 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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products:
      a. Aeroflex USA Inc.; Aeroseal.
      b. Armacell LCC; 520 Adhesive.
      c. Foster Products Corporation, H. B. Fuller Company; 85-75.
      d. RBX Corporation; Rubatex Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products:
      a. Childers Products, Division of ITW; CP-82.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

   1. Products:
      a. Childers Products, Division of ITW; CP-82.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products:
      a. Dow Chemical Company (The); 739, Dow Silicone.
      d. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide the following:
   a. Childers Products, Division of ITW; CP-35.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.

2.5 SEALANTS

A. Joint Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.

B. ASJ Flashing Sealants, and Vinyl, and PVC Jacket Flashing Sealants:
1. Products:
   a. Childers Products, Division of ITW; CP-76.
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 F.

2.6 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
1. Products:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

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.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

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 1-1/2 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 2 inches o.c.
   a. For below ambient services, 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 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.

P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions on piping. 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.

1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

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.

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.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe
insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with 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.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed 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 mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
1. NPS 1 and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
   b. Flexible Elastomeric, Type II: 1 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Piping insulation not required on cold water vertical pipe risers where located within insulated walls. Refer to the architectural plans and wall construction documents and details for corresponding insulation for plumbing in rated and non-rated walls.

B. Domestic Hot and Recirculated Hot Water:
1. NPS 1 and Smaller: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
   b. Flexible Elastomeric, Type II: 1 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Piping insulation not required on hot water vertical pipe risers where located within insulated walls. Refer to the architectural plans and wall construction documents and details for the corresponding insulation for plumbing in rated and non-rated walls.

C. Storm water and Primary Rainwater Leaders:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. Piping insulation not required on storm water vertical pipe risers where located within insulated walls. Refer to the architectural plans and wall construction documents and details for the corresponding insulation for plumbing in rated and non-rated walls.
3.

D. Rainwater Leaders from Overflow:
1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
2. Piping insulation not required on overflow storm water vertical pipe risers where located within insulated walls. Refer to the architectural plans and wall construction documents and details for the corresponding insulation for plumbing in rated and non-rated walls.

E. Roof Drain and Overflow Drain Bodies:
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric, Type II: 1 inch thick.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 220700
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 for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

B. Related Sections include the following:
   1. Division 22 Section "Sanitary Waste Piping Specialties."
   2. Division 22 Section "Sanitary Sewerage Pumps."

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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 the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.
2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
      a. Manufacturers:
         1) ANACO.
         2) Fernco, Inc.
         3) Ideal Div.; Stant Corp.
         4) Mission Rubber Co.
         5) Tyler Pipe; Soil Pipe Div.
      a. Manufacturers:
         1) ANACO.
         2) Clamp-All Corp.
         3) Ideal Div.; Stant Corp.
         4) Mission Rubber Co.
         5) Tyler Pipe; Soil Pipe Div.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Hard Copper Tube: ASTM B 88, Types L and M water tube, drawn temper.
   2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.6 SPECIAL PIPE FITTINGS

A. Flexible, Shielded, Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      b. Mission Rubber Co.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Excavation and Fill" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Aboveground, condensate drainage piping NPS 4 and smaller shall be any of the following:
1. Copper DWV tube, copper drainage fittings, and soldered joints.

E. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
   a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 Hard copper tube, Type M; copper pressure fittings; and soldered joints.
4. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

F. Underground, soil, waste and vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and hubless-coupling joints.
3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and hubless-coupling joints.
3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

A. Sanitary sewer piping outside the building is specified in Division 33 Section "Sanitary Sewer."

B. Basic piping installation requirements are specified in Division 22 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers. Utilize long sweep elbows and wyes to connect to sanitary drainage system.

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Basic Mechanical Materials and Methods."


C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:
      a. MSS Type 1, adjustable, steel clevis hangers.
   3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.
   5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3: 10 feet with 1/2-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316
SECTION 221319
SANITARY WASTE PIPING SPECIALTIES

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 sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Roof flashing assemblies.
   4. Through-penetration firestop assemblies.

1.3 QUALITY ASSURANCE
A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 COORDINATION
A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS
A. Exposed Metal Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide one of the following:
      b. MIFAB, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
   3. Size: Same as connected drainage piping
   4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
   6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
B. Metal Floor Cleanouts:
   1. Manufacturers: Subject to compliance with requirements, provide one of the following:
c. Tyler Pipe; Wade Div.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
5. Seepage Flange: Not required.
6. Anchor Flange: Not required.
7. Clamping Device: Not required.
8. Outlet: Bottom.
10. Sediment Bucket: Not required.
11. Top or Strainer Material: Nickel bronze.
13. Top Shape: Round.
15. Funnel: Not required.
16. Inlet Fitting: Not required.
17. Trap Material: Cast iron.
19. Trap Features: Cleanout.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide one of the following:
      a. Acorn Engineering Company; Elmdor/Stoneman Div.
      b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Manufacturer: Subject to compliance with requirements, provide one of the following:
      a. ProSet Systems Inc.
   2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
   3. Size: Same as connected soil, waste, or vent stack.
   4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
   6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Hub Drains:
   1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
   2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:
   1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
   2. Size: Same as connected waste piping.
      a. NPS 2: 4-inch- minimum water seal.
      b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Sleeve Flashing Device:
   1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
   2. Size: As required for close fit to riser or stack piping.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Refer to Division 22 Section “Common Work Results for Plumbing” for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

H. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS
A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION
A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319
SECTION 221416
STORM DRAINAGE PIPING

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 storm drainage piping inside the building:
   1. Pipe and fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.
   2. Storm Sewer, Force-Main Piping: 50 psig.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
      a. Manufacturers:
         1) ANACO.
2) Fernco, Inc.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

   a. Manufacturers:
      1) ANACO.
      2) Clamp-All Corp.
      3) Ideal Div.; Stant Corp.
      4) Mission Rubber Co.
      5) Tyler Pipe; Soil Pipe Div.

2.5 SPECIAL PIPE FITTINGS

A. Flexible, Shielded, Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
   1. Manufacturers:
      b. Mission Rubber Co.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Excavation and Fill" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Aboveground storm drainage piping shall be the following:
   1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
   2. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

B. Underground storm drainage piping shall be the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless cast-iron soil pipe and fittings; heavy-duty, shielded, stainless-steel couplings; and hubless-coupling joints.
   3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 22 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Utilize long sweep elbows and wyes to connect to storm drainage system. Cleanouts are specified in Division 22 Section "Plumbing Specialties."

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make
installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Basic Mechanical Materials and Methods."

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Basic Mechanical Materials and Methods."


3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. MSS Type 1, adjustable, steel clevis hangers.
   3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3: 60 inches with 1/2-inch rod.
   2. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
3. NPS 6: 60 inches with 3/4-inch rod.
4. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron piping every 15 feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

END OF SECTION 221416
SECTION 221423
STORM DRAINAGE PIPING SPECIALTIES

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 storm drainage piping specialties:
      1. Cleanouts.
      2. Roof drains.

1.3 QUALITY ASSURANCE
   A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.4 COORDINATION
   A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS
   A. Exposed Metal Cleanouts:
      1. Manufacturers: Subject to compliance with requirements, provide products from the following manufacturers:
         b. MIFAB, Inc.
         d. Tyler Pipe; Wade Div.
         e. Watts Drainage Products Inc.
         f. Zurn Plumbing Products Group; Specification Drainage Operation.
      2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
      3. Size: Same as connected drainage piping
      4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
      5. Closure: Countersunk, cast-iron plug.
      6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

   B. Metal Floor Cleanouts:
      1. Manufacturers: Subject to compliance with requirements, provide products from the following manufacturers:
         b. Oatey.
         c. Sioux Chief Manufacturing Company, Inc.
         e. Tyler Pipe; Wade Div.
         f. Watts Drainage Products Inc.
         g. Zurn Plumbing Products Group; Light Commercial Operation.
         h. Zurn Plumbing Products Group; Specification Drainage Operation.
      2. Standard: ASME A112.36.2M for adjustable housing cleanout.
      3. Size: Same as connected branch.
      4. Type: Adjustable housing.
      5. Body or Ferrule: Cast iron.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Wall Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products from the following manufacturers:
   b. MIFAB, Inc.
   d. Tyler Pipe.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Wall Access: [Round] [Square], [nickel-bronze, copper-alloy, or stainless-steel] <Insert material> wall-installation frame and cover.

2.2 ROOF DRAINS

A. Metal Roof Drains:
1. Manufacturers: Subject to compliance with requirements, provide products from the following manufacturers:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.2M.
3. Pattern: Roof drain.
5. Combination Flashing Ring and Gravel Stop: Required.
7. Outlet: Bottom.
10. Underdeck Clamp: Required.
12. Dam: 2" required for overflow drains.

2.3 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.

B. Floor Cleanouts: Cast-iron body and frame; cleanout plug; adjustable round top as follows:
1. Nickel Bronze Top: Manufacturers standard cast unit of pattern indicated:
   a. Pattern: Exposed rim type, with recess to receive 1/8" thick resilient floor finish.
   b. Pattern: Exposed rim type, with recess to receive 1" thick terrazzo floor finish.
c. Pattern: Exposed finish type, standard mill finish.
d. Pattern: Exposed flush type, standard non-slip scored or abrasive finish.

2. Cast-Iron Top: Manufacturer standard cast unit of the pattern indicated:
   a. Pattern: Exposed flush type, standard mill finish.
   b. Pattern: Exposed flush type, standard non-slip scored or abrasive finish.

C. Wall Cleanouts: Cast-iron body adaptable to pipe with cast-bronze or brass cleanout plug; stainless steel cover including screws.

D. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.

E. Deck Drain: Cast iron square promenade deck drain with flashing clamp, ductile iron secured heel proof grate and no-hub bottom outlet. Wade model 3200P.

F. Through-Penetration Firestop Assemblies:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ProSet Systems Inc.
   2. Standard: ASTM E 814, for through-penetration firestop assemblies.
   4. Size: Same as connected pipe.
   5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
   7. Special Coating: Corrosion resistant on interior of fittings.

2.4 FLASHING MATERIALS

   A. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

   B. Fasteners: Metal compatible with material and substrate being fastened.

   C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

   D. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

   A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

   B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
      1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
      2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 7.
1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

E. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 FLASHING INSTALLATION

A. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

B. Set flashing on floors and roofs in solid coating of bituminous cement.

C. Secure flashing into sleeve and specialty clamping ring or device.

D. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423
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 sump pumps and accessories, inside the building, for building storm drainage systems:
   1. Submersible sump pumps.
   2. Sump pump basins.

1.3 SUBMITTALS

A. Product Data: For each type and size of sump pump specified. Include certified performance curves with operating points plotted on curves, and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For each sump pump to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sump pumps and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.6 COORDINATION

A. Coordinate size and location of anti-flotation concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

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 SUBMERSIBLE SUMP PUMPS

A. Manufacturers:
   1. Bell & Gossett Domestic Pump; ITT Industries.
   2. Federal Pump Corp.
   4. Hydromatic.
   5. Weil Pump Company, Inc.

B. Description: Factory-assembled and -tested, single-stage, close-coupled, overhung-impeller, centrifugal, submersible, direct-connected sump pumps complying with UL 778 and HI 1.1-1.2 and HI 1.3 for submersible sump pumps.

C. Casing: Cast iron; with legs that elevate pump to permit flow into impeller, and vertical discharge with threaded or companion flange for piping connection.

D. Impeller: Corrosion resistant cast-iron or bronze; statically and dynamically balanced, semi-open non-clog design for clear wastewater handling, overhung, single suction, keyed and secured to shaft.

E. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.

F. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump. Comply with requirements in Division 22 Section "Motors."
   1. Motor Housing Fluid: Oil.

G. Basin Cover: Steel with bituminous coating and strong enough to support floor traffic. See Part 2 "Sump Pump Basins" Article for other requirements.

H. Controls: NEMA 250, Type 6, 120-V ac, float switch, mounted on discharge piping.

I. Controls:
   1. Enclosure: NEMA 250, Type 4X; wall-mounted.
   2. Switch Type: Pressure type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables
   3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
   4. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with float switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

J. Sump Pump(s) Capacity: Refer to equipment schedules.

2.3 SUMP PUMP BASINS

A. Description: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.

B. Sump Basin: Refer to plans and schedules for basin size and inlet connection orientation.
   2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
   3. Anchor Flange: Same material as or compatible with sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
C. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
   1. Material: Steel with bituminous coating.
   2. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of plumbing piping to verify actual locations of drainage piping connections before sump pump installation.

3.2 SUMP PUMP INSTALLATION

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Excavation and Fill."

B. Install sump pumps according to applicable requirements in HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sump pumps on basin floor. Make direct connections to storm drainage piping.

E. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.

F. Support piping so weight of piping is not supported by pumps.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 22 Section "Sanitary Drainage Piping" and "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to sump pumps to allow service and maintenance.

B. Connect to sanitary drainage system via standpipe drain through air gap. Install discharge piping equal to or greater than size of pump discharge piping. Refer to Division 22 Section "Sanitary Drainage Piping."
   1. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Section "General Duty Valves for Plumbing Piping."

C. Connect to storm drainage system. Install discharge piping equal to or greater than size of pump discharge piping. Refer to Division 22 Section "Storm Drainage Piping."
1. Install check and shutoff valves on discharge piping from each pump. Install unions on pumps having threaded pipe connections. Install valves same size as connected piping. Refer to Division 22 Section "General Duty Valves for Plumbing Piping."

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 **STARTUP SERVICE**

A. Start pumps without exceeding safe motor power:
   1. Start motors.
   2. Open discharge valves slowly.
   3. Check general mechanical operation of pumps and motors.

B. Test and adjust controls and safeties.

C. Remove and replace damaged and malfunctioning components.
   1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
   2. Set field-adjustable switches and circuit-breaker trip ranges, for normal operation.

3.5 **DEMONSTRATION**

A. Contractors shall provide Owner's maintenance personnel with Operations and Maintenance manuals as required. Refer to Division 1 Section "Operation and Maintenance Data."

**END OF SECTION 221429**
SECTION 230500
COMMON WORK RESULTS 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:
   1. Piping materials and installation instructions common to most piping systems.
   2. Condensate piping
   3. Transition fittings.
   4. Dielectric fittings.
   5. Mechanical sleeve seals.
   6. Condensate Piping.
   7. Sleeves.
   8. Escutcheons.
   10. Equipment installation requirements common to equipment sections.
   11. Concrete bases.
   12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators per AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, disconnects, wire sizes and conduit sizes are appropriately modified at no cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
1.5 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Any system redesign that may be required as result of selecting a differing approved piece of equipment is incumbent on the mechanical contractor to perform.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

E. Any system redesign resulting from the selection of alternate equipment and/or material is incumbent on the contractor to perform. Any redesigned system shall be submitted to the authority having jurisdiction for review and approval. Modifications and resubmittals will be by the contractor. Changes shall be submitted to the Engineer for review prior to resubmission.

F. Any contractor suggested and accepted alternates or changes that require document revisions shall be by the contractor. The contractor is responsible for any design and or document resubmittals to the Authority Having Jurisdiction. Changes shall be submitted to the Engineer for review prior to resubmission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 HVAC PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for HVAC pipe, tube, and fitting materials and joining methods.

2.3 JOINING MATERIALS
A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux per ASTM B 813.

C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 CONDENSATE PIPING

A. Description: Provide condensate piping sized as per code for all equipment that generates condensate.
   1. Risers:
      a. Provide for stacked pieces of equipment on multiple floors.
      b. Make all required connections include traps.
      c. Connect individual pieces of equipment to risers as per code.
   2. Terminations: Ensure that all condensate piping whether from individual pieces of equipment or many pieces of equipment connected in a common riser terminate at a code compliant location with the appropriate air gap. Verify approved location with the local authority.
   3. Neutralization: Any high efficiency condensate producing equipment shall be provided with a neutralization package.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer’s Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer’s SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC, PVC, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

2.6 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Eclipse, Inc.
      d. Epco Sales, Inc.
      g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 300-psig minimum working pressure as required to suit system pressures.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.

2.7 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Carbon steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

A. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

B. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.9 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

D. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.

E. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HVAC PIPING & DUCT SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size HVAC piping and ductwork and calculate friction loss, expansion, fan and pump sizing, and other design considerations. Install HVAC piping and ductwork as indicated unless deviations to layout are approved on Coordination Drawings. Not all pipe valves, fittings, duct fittings and appurtenances may be shown but are nonetheless still required to be included by the contractor.

C. Coordination Drawings: Using 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. Any and all other systems installed in same space as ducts.
   3. Ceiling- and wall-mounting access doors and panels required to provide access to valves, dampers and other operating devices.
   4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, fire sprinklers, access panels, and special moldings.

D. Install HVAC piping and ductwork in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

E. Install HVAC piping and ductwork indicated to be exposed and HVAC piping and ductwork in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise. Install to maintain maximum headroom.

F. Install HVAC piping and ductwork above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install HVAC piping to permit valve servicing.

H. Install ductwork appurtenances such as fire, smoke, fire/smoke and control dampers to permit damper motor access and servicing.

I. Install HVAC piping at indicated slopes.

J. Install HVAC piping free of sags and bends.

K. Install HVAC piping and ductwork fittings for changes in direction and branch connections.

L. Install HVAC piping and ductwork to allow application of insulation.

M. Install HVAC piping with code approved puncture protection.

N. Select HVAC piping and ductwork system components with pressure rating equal to or greater than system operating pressure.

O. Install escutcheons for penetrations of walls, ceilings, and floors per the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

P. Install sleeves for HAVC pipes passing through concrete and masonry walls and concrete floor and roof slabs.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 HVAC PIPING JOINT CONSTRUCTION

A. Join HVAC pipe and fittings per the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints per ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads per ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 HVAC PIPING CONNECTIONS

A. Make connections per the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Ensure all equipment is set providing the manufactures minimum service and intake/exhaust air clearance requirements. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

### 3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base per equipment manufacturer's written instructions and per codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. 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 the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts per anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

### 3.7 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

### 3.8 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 9 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
3.9 PERMITTING

A. Contractor shall pay for gas connection and all other required connection charges.

END OF SECTION 230500
SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.
   5. Motor Efficiency Requirements.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 7500 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium Energy efficient. Include a brush grounding kit where used with VFD.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T

2.4 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.

B. Efficiency: Premium Efficiency.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513
SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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 mechanical system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Equipment supports.

B. Related Sections include the following:
   1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 23 Section "Mechanical Vibration and Seismic Controls" for vibration isolation devices.
   3. Division 23 Section(s) "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 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.
   4. Pipe positioning systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Pipe stands. Include Product Data for components.
   4. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.3, "Structural Welding Code--Sheet Steel."

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 STEEL 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:
   2. B-Line Systems, Inc.; a division of Cooper Industries.
   3. Carpenter & Paterson, Inc.
   4. ERICO/Michigan Hanger Co.
   5. Globe Pipe Hanger Products, Inc.
   6. Grinnell Corp.
   7. PHD Manufacturing, Inc.
   8. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
   2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   4. Thomas & Betts Corporation.
   5. Tolco Inc.
   6. 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.

2.5 THERMAL-HANGER SHIELD INSERTS
A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. Pipe Shields, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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. 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:
      b. Empire Industries, Inc.
      c. Hilti, Inc.
      d. ITW Ramset/Red Head.
      e. MKT Fastening, LLC.
      f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
   1. Manufacturers:
      a. Portable Pipe Hangers.
      2. Bases: One or more plastic.
      3. Vertical Members: Two or more protective-coated-steel channels.
      4. Horizontal Member: Protective-coated-steel channel.
      5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
2.8 EQUIPMENT SUPPORTS
A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS
A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

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. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. 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): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   3. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
   4. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
   5. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   6. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
   7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
   8. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 30.

G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
3. C-Clamps (MSS Type 23): For structural shapes.
4. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

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

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

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. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that
are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

O. Insulated Piping: Comply with the following:
1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 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 1-1/2 inches or less.

END OF SECTION 230529
SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

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. Elastomeric isolation pads and mounts.
2. Freestanding and restrained spring isolators.
3. Elastomeric hangers.
4. Spring hangers.
5. Inertia, vibration isolation equipment bases.

1.3 PERFORMANCE REQUIREMENTS

A. Performance Criteria Factor: Refer to equipment schedule for value for each piece of equipment.
B. Attachment Amplification Factor: Refer to equipment schedule for value for each piece of equipment.

1.4 SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.
B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

1.6 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VIBRATION ISOLATORS

A. Manufacturers:
1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
4. Mason Industries, Inc.

B. Elastomeric Isolator Pads (Mason Industries, Type BBNR): Oil- and water-resistant elastomer or natural rubber, arranged in 1” thick single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
   2. Number of Layers: 1.
   3. Deflection: 1/8”.

C. Elastomeric Mounts (Mason Industries, Type ND): Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
   1. Minimum Deflection: 0.35”.

D. Spring Isolators (Mason Industries, Type SLF): Freestanding, laterally stable, open-spring isolators.
   1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   3. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
   4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.
   6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators (Mason Industries, Type SLR): Freestanding, steel, open-spring isolators with seismic restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Elastomeric Hangers (Mason Industries, Type HD): Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
   1. Maximum deflection: 1”.

G. Spring Hangers (Mason Industries, Type HS): Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide the product indicated on drawings or a comparable product by one of the following:
   1. Amber/Booth Company, Inc.
   2. Isolation Technology, Inc.
   5. Vibration Eliminator Co., Inc.
   6. Vibration Mountings & Controls, Inc.

   1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
      a. Include supports for suction and discharge elbows for pumps.
   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
   4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 FACTORY FINISHES

A. Finish: Manufacturer’s standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
   3. Baked enamel for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Horizontal Fan Coil Units: Suspend from roof or floor structure using four elastomeric hangers.

B. Axial HVAC fans and in-line centrifugal fans: Suspend from roof or floor structure using four combination coil-spring and elastomeric-insert hangers with spring and insert in compression.

C. Pumps: Support pumps located on upper level floors on inertia bases.
D. Chillers: Support off structural steel using restrained spring isolators.

3.3 INSTALLATION

A. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

3.4 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 CLEANING

A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION 230548
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 mechanical identification materials and their installation:
   1. Equipment markers.
   2. Pipe markers.
   3. Valve tags.
   4. Valve schedules.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Valve numbering scheme.
C. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.4 QUALITY ASSURANCE


1.5 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 location of access panels and doors.
C. Install identifying devices before installing 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, \( \frac{1}{8}\) inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black.
   4. Maximum Temperature: Able to withstand temperatures up to 180 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
   B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
C. 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 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, beaded chain 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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

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 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
   1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use size to ensure a tight fit.
B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
   1. Near each branch connection. Where flow pattern is not obvious, mark each pipe at branch.
   2. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
3. At access doors, manholes, and similar access points that permit view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced at maximum intervals of 30 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.

C. Pipe Label Color Schedule:
   1. Chilled Water Piping:
      a. Background Color: Blue.
   2. Heating Water Piping:
      a. Background Color: Yellow.
      b. Letter Color: Black.
   3. Natural Gas Piping
      a. Background Color: Yellow
      b. Letter Color: Black

3.4 VALVE-.getTag INSTALLATION

A. Install tags on valves and control devices in piping systems. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
   2. Valve-Tag Color:
      b. Hot Water: Yellow.
      c. Gas: Yellow.
   3. Letter Color:
      b. Hot Water: Black.
      c. Gas: Black.

3.5 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.6 CLEANING

A. Clean faces of mechanical identification devices.

END OF SECTION 220553
SECTION 230593
TESTING, ADJUSTING, AND BALANCING

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 TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
      b. Fan Coil Systems.
   2. Hydronic Piping Systems:
   3. HVAC equipment quantitative-performance settings.
   4. Reporting results of activities and procedures specified in this Section.

1.3 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 indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. 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.

E. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

F. Report Forms: Test data sheets for recording test data in logical order.

G. 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.

H. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

I. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

J. 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.

K. TAB: Testing, adjusting, and balancing.

L. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
M. Test: A procedure to determine quantitative performance of systems or equipment.

N. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

B. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.


D. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."

E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

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 TAB activities.

B. Notice: Provide seven days’ advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
   1. The certified TAB firm 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 the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of 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 Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

F. Examine system and equipment test reports.

G. 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 that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

K. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

L. Examine strainers for clean screens and proper perforations.

M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine system pumps to ensure absence of entrained air in the suction piping.
P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
   5. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at indicated values.
   9. Interlocked systems are operating.
   10. Changeover from heating to cooling mode occurs according to indicated values.

R. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB 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. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" 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 insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.
3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

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. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling unit components.

K. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by 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 component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      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. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. 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 that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated 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 submain 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 submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
   2. Do not use dampers at diffusers and registers for balancing airflow.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated 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 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check make-up-water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presetsettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
   1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
   3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

H. Adjust pump discharge pressure to the lowest setting possible to achieve balance at the most remote hydronic terminal.

I. Balance hydronic units at peak cooling and peak heating conditions for each air outlet.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer, model, and serial numbers.
   4. Efficiency rating.
   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.

3.9 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the 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 two successive eight-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.

3.10 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with 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, 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 three-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 instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to 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 Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
   a. Indicated versus final performance.
   b. Notable characteristics of systems.
   c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. 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. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer’s serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Sheave make, size in inches, and bore.
   i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
   j. Number of belts, make, and size.
   k. Number of filters, type, and size.

2. Motor Data:
   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Preheat coil static-pressure differential in inches wg.
   g. Cooling coil static-pressure differential in inches wg.
   h. Heating coil static-pressure differential in inches wg.
   i. Outside airflow in cfm.
   j. Return airflow in cfm.
   k. Outside-air damper position.
   l. Return-air damper position.
   m. Vortex damper position.

G. Apparatus-Coil Test Reports:
1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outside-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
   m. Refrigerant suction pressure in psig.
   n. Refrigerant suction temperature in deg F.

H. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
   1. Unit Data:
      a. System identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Fuel type in input data.
      g. Output capacity in Btuh.
      h. Ignition type.
      i. Burner-control types.
      j. Motor horsepower and rpm.
      k. Motor volts, phase, and hertz.
      l. Motor full-load amperage and service factor.
      m. Sheave make, size in inches, and bore.
      n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
   2. Test Data (Indicated and Actual Values):
      a. Total airflow rate in cfm.
      b. Entering-air temperature in deg F.
      c. Leaving-air temperature in deg F.
      d. Air temperature differential in deg F.
      e. Entering-air static pressure in inches wg.
      f. Leaving-air static pressure in inches wg.
      g. Air static-pressure differential in inches wg.
      h. Low-fire fuel input in Btuh.
      i. High-fire fuel input in Btuh.
      j. Manifold pressure in psig.
      k. High-temperature-limit setting in deg F.
      l. Operating set point in Btuh.
      m. Motor voltage at each connection.
      n. Motor amperage for each phase.
      o. Heating value of fuel in Btuh.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
   1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:
1. Unit Data:
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.
2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Air velocity in fpm.
c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.
L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
   1. Unit Data:
      a. System and air-handling unit identification.
      b. Location and zone.
      c. Room or riser served.
      d. Coil make and size.
      e. Flowmeter type.
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Entering-water temperature in deg F.
      c. Leaving-water temperature in deg F.
      d. Water pressure drop in feet of head or psig.
      e. Entering-air temperature in deg F.
      f. Leaving-air temperature in deg F.

M. Chiller Test Reports: For chillers, include the following:
   1. Unit Data:
      a. Unit identification.
      b. Make and type.
      c. Model and serial numbers.
      d. Nominal cooling capacity in tons.
      e. Number of compressors.
      f. Number and type of fans.
   2. Air-Cooled Condenser Test Data:
      a. Refrigerant pressure in psig.
      b. Refrigerant temperature in deg F.
   3. Compressor Test Data (Indicated and Actual Values):
      a. Suction pressure in psig.
      b. Suction temperature in deg F.
      c. Discharge pressure in psig.
      d. Discharge temperature in deg F.
      e. Oil pressure in psig.
      f. Oil temperature in deg F.
      g. Voltage at each connection.
      h. Amperage for each phase.
      i. Kilowatt input.
      j. Crankcase heater kilowatt.
   2. Water Test Data (Indicated and Actual Values):
      a. Entering-water temperature in degrees F.
      b. Leaving-water temperature in degrees F.
      c. Water temperature differential in degrees F.
      d. Entering-water pressure in feet of head or psig.
      e. Leaving-water pressure in feet of head or psig.
      f. Water pressure differential in feet of head or psig.
      g. Water flow rate in gpm.

N. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
   1. Unit Data:
      a. Unit identification.
      b. Location.
      c. Service.
      d. Make and size.
      e. Model and serial numbers.
      f. Water flow rate in gpm.
      g. Water pressure differential in feet of head or psig.
      h. Required net positive suction head in feet of head or psig.
      i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

O. Boiler Test Reports:
1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Fuel type and input in Btuh.
g. Number of passes.
h. Ignition type.
i. Burner-control types.
j. Voltage at each connection.
k. Amperage for each phase.

2. Test Data (Indicated and Actual Values):
a. Operating pressure in psig.
b. Operating temperature in deg F.
c. Entering-water temperature in deg F.
d. Leaving-water temperature in deg F.
e. Number of safety valves and sizes in NPS.
f. Safety valve settings in psig.
g. High-limit setting in psig.
h. Operating-control setting.
i. High-fire set point.
j. Low-fire set point.
k. Voltage at each connection.
l. Amperage for each phase.
m. Draft fan voltage at each connection.
n. Draft fan amperage for each phase.
o. Manifold pressure in psig.

P. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.
3.13 INSPECTIONS

A. Initial Inspection:
   1. After the initial inspection, readiness checklists, and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
   2. Randomly check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure water flow of at least 5 percent of terminals.
      c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      d. Measure sound levels at two locations.
      e. Measure space pressure of at least 10 percent of locations.
      f. Verify that balancing devices are marked with final balance position.
      g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:
   1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner and mechanical engineer with the balancing contractor present. Notify the Owner and engineer at least 10 days in advance of the Final Inspection.
   2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
   3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
   4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
   5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
   6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
   7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing TAB and final report, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct and usual conditions. Owners representative along with the Mechanical Engineer must be present for this 90 day test.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593
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. Section Includes:
   1. Insulation Materials:
      a. Mineral fiber.
      b. Flexible elastomeric.
   2. Adhesives.
   3. Sealants.
   4. Factory-applied jackets.
   5. Tapes.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. 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.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. 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, 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.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Products: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products:
      a. CertainTeed Corp.; Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; All-Service Duct Wrap.
G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products:
      a. CertainTeed Corp.; Commercial Board.
      b. Fibrex Insulations Inc.; FBX.
      c. Johns Manville; 800 Series Spin-Glas.
      d. Knauf Insulation; Insulation Board.
      e. Manson Insulation Inc.; AK Board.
      f. Owens Corning; Fiberglas 700 Series.

H. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products:
      a. Fibrex Insulations Inc.; Coreplus 1200.
      b. Johns Manville; Micro-Lok.
      c. Knauf Insulation; 1000 Pipe Insulation.
      d. Manson Insulation Inc.; Alley-K.
      e. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products:
      a. CertainTeed Corp.; CrimpWrap.
      b. Johns Manville; MicroFlex.
      c. Knauf Insulation; Pipe and Tank Insulation.
      d. Manson Insulation Inc.; AK Flex.
      e. Owens Corning; Fiberglas Pipe and Tank Insulation.

J. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.3 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products:
      a. Childers Products, Division of ITW; CP-82.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products:
a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

   1. Products:
      a. Childers Products, Division of ITW; CP-82.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.
   1. Products:
      a. Dow Chemical Company (The); 739, Dow Silicone.
      d. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F.

B. FSK Flashing Sealants:
   1. Products:
      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 F.
   5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Products:
      a. Childers Products, Division of ITW; CP-76.
   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 F.

2.5 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Johns Manville; Zeston.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
  1. Products:
     a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
     b. Compac Corp.; 104 and 105.
     c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
     d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Products:
     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.
  3. Thickness: 6.5 mils.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.8 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

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.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

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 1-1/2 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 2 inches o.c.
      a. For below ambient services, 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 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.

P. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
   3. Nameplates and data plates.
   5. Handholes.
   6. Cleanouts.
3.4 PENETRATIONS

A. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions on piping. 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. 1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.5 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

   1. NPS 1-1/4" and Smaller: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe, Type I: 1.0 inch thick.
   2. NPS 1-1/2" and Larger: Insulation shall be the following:
      a. Mineral Fiber, Preformed Pipe, Type I: 1.5 inches thick.

C. Heating-Hot-Water Supply and Return (141F - 200F):
   1. NPS 1-1/4" and Smaller: Insulation shall be the following:
   2. NPS 1-1/2" and Larger: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick

END OF SECTION 230700
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 control sequences for HVAC systems, subsystems, and equipment.

B. See Division 23 Section "HVAC Instrumentation and Controls" for control equipment and devices and for submittal requirements.

1.3 DESCRIPTION OF WORK

A. Control sequences are hereby defined as the manner and method by which automatic temperature controls function. Requirements for each type of operation are specified in this section.

B. Operating equipment, devices, and system components required for control systems are specified in other Division-23 sections of these specifications.

C. Provide all equipment, devices, and system components required to accomplish the control sequences described in this section and the related equipment sections. Equipment, devices, and system components not specified in other related Division 21, 22, 23, and 26 sections but necessary to accomplish the complete operating system specified in this section and related sections shall be provided by this contractor all equipment, devices, and system components required to accomplish the control sequences described in this section. Equipment, devices, and system components not specified in other Division-23 sections but necessary to accomplish the sequences specified in this division will be provided.

1.4 DEFINITIONS

A. Set Points: All system set points will be operator adjustable unless specifically noted.

B. Temperatures: All temperatures listed are degrees Fahrenheit (°F).

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 ELEVATOR EQUIPMENT ROOM SEQUENCE

A. General: The elevator equipment room is heated and cooled by a wall-hung packaged terminal air conditioning unit (PTAC).

3.2 DEMONSTRATION

A. Each Contractor is responsible for contractor participation as outlined in Division 1 Section 01810, "Commissioning."
B. Contractors shall engage factory-authorized service representatives to train Commissioning Agents and Owner's maintenance personnel to adjust, operate, and maintain HVAC equipment controls system and sequences of operation. Refer to Division 1 Section, "Demonstration and Training."

C. Contractors shall provide Owner's maintenance personnel with Operations and Maintenance manuals as required. Refer to Division 1 Section, "Operation and Maintenance Data."

END OF SECTION 230993
PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
      1. Hot-water heating piping.

1.2 PERFORMANCE REQUIREMENTS
   A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
      1. Hot-Water Heating Piping: 125 psig at 200 deg F.

1.3 SUBMITTALS
   A. Product Data: For each type of the following:
      1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
      2. Hydronic specialties.
   B. Field quality-control test reports.
   C. Operation and maintenance data.

1.4 QUALITY ASSURANCE
   A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS
   A. Drawn-Temper Copper Tubing: ASTM B 88, Type L ASTM B 88, Type K.
   B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
   C. DWV Copper Tubing: ASTM B 306, Type DWV.
   D. Wrought-Copper Fittings: ASME B16.22.
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Anvil International, Inc.
         b. Victaulic Company of America.
      2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
      3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
   E. Wrought-Copper Unions: ASME B16.22.
2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

D. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.

E. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. Victaulic Company of America.
   2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

F. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.
2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Central Plastics Company.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
   2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Couplings:
   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. Calpico, Inc.
      b. Lochinvar Corporation.
   2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.5 VALVES

A. Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Flow Design Inc.
      d. Griswold Controls.
      e. Taco.
      f. Tour & Andersson; available through Victaulic Company of America
   2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   3. Ball: Brass or stainless steel.
   4. Plug: Resin.
   5. Seat: PTFE.
   6. End Connections: Threaded or socket.
   8. Handle Style: Lever, with memory stop to retain set position.
   10. Maximum Operating Temperature: 250 deg F.

D. Automatic Flow-Control Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Flow Design Inc.
b. Griswold Controls.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
9. Maximum Operating Temperature: 250 deg F.

E. Plastic Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Colonial Engineering.
   c. NIBCO INC.
   d. Plast-O-Matic Valves, Inc.
   e. SMC The Specialty Mfg. Co.
   f. Thermoplastic Valves Inc.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: One-, two-, or three-piece PVC to match piping.
3. Ball: Full-port PVC to match piping.
4. Seats: PTFE.
5. Seals: EPDM.
6. End Connections: Socket, union, or flanged.
7. Handle Style: Tee shape.
8. CWP Rating: Equal to piping service.
10. Comply with MSS SP-122.

2.6 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

B. Stainless-Steel Bellow, Flexible Connectors:
2. End Connections: Threaded or flanged to match equipment connected.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

C. Spherical, Rubber, Flexible Connectors:
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

D. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
   2. Schedule 40 steel pipe; Class 125, cast-iron or 150, malleable-iron threaded fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and NPS 3, shall be any of the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or pressure-seal joints.
   2. Schedule 40 steel pipe; Class 125, cast-iron or 150, malleable-iron threaded fittings; and threaded joints.
   3. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
   4. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

### 3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
   7. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
   8. NPS 3-1/2: Maximum span, 13 feet; minimum rod size, 1/2 inch.
   9. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.

D. Install hangers for drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 3/8 inch.
   2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
   3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
   4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 1/2 inch.
   7. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Pressure Piping: Join ASTM D1785 schedule number, PVC pipe and PVC socket fitting according to ASTM D2672. Join other than schedule number PVC pipe and socket fittings according to ASTM D2855.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.7 CHEMICAL TREATMENT

A. Partial drainage of the existing hydronic heating water system is required for completing the Work. Provide necessary equipment and schedule the Work with the Owner.

B. Replace hydronic heating water with like brine solution per existing system contents. Coordinate with the Owner concerning type and concentration.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
   1. Open manual valves fully.
   2. Inspect pumps for proper rotation.
   3. Set makeup pressure-reducing valves for required system pressure.
   4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
   5. Set temperature controls so all coils are calling for full flow.
   6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
   7. Verify lubrication of motors and bearings.

END OF SECTION 232113
SECTION 238113
PACKAGED TERMINAL 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 packaged terminal air conditioners and their accessories and controls, in the following configurations:

1. Cooling units with electric heat.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, electrical characteristics, and accessories.

B. Shop Drawings: For packaged terminal air conditioners. Include plans, elevations, sections, details for wall penetrations, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver, and for each color and texture specified. Discharge grille shall be field painted to match exterior colors as directed by Architect.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for packaged terminal air conditioners.

E. Field quality-control reports.

F. Operation and Maintenance Data: For packaged terminal air conditioners to include in emergency, operation, and maintenance manuals.

G. Warranty: Sample of special warranty.

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.


1.5 COORDINATION

A. Coordinate layout and installation of packaged terminal air conditioners and wall construction with other construction that penetrates walls or is supported by them.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged terminal air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and replacement or repair labor.
2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than one years from date of Substantial Completion, including only components and including labor.
3. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS – THROUGH WALL SELF CONTAINED AIR CONDITIONERS (STANDARD EFFICIENCY)

A. Description: Factory-assembled and -tested, self-contained, packaged terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis.

2.2 MANUFACTURERS

A. Manufacturers:
   1. Islandaire EZ Series 42, packaged cooling with electric heat.
   2. GREE GAE Series, packaged cooling with electric heat.
   3. Amana PTAC, packaged cooling with electric heat.

2.3 CHASSIS

A. Cabinet: Thick steel with removable front panel with concealed latches.

1. Mounting: Wall with wall sleeve and or Floor with subbase.
2. Discharge Grille: Punched-louver discharge grille allowing four-way discharge-air pattern or where noted on plan include Extruded-aluminum discharge grille.
3. Louvers: Extruded aluminum with enamel finish or as noted on plan Stamped aluminum with clear-anodized finish; Architectural color.
5. Access Door: Hinged door in top of cabinet for access to controls.
6. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.
7. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2010.
8. Subbase: Enamed steel with adjustable leveling feet and adjustable end plates, with factory-installed and -wired, fused disconnect switch and receptacle sized for unit.
B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor; and hermetically sealed scroll compressor with vibration isolation and overload protection.

1. Indoor and Outdoor Coils: Seamless copper rifled tubes mechanically expanded into laced aluminum fins with capillary tube distributor on indoor coil.
2. Accumulator.
3. Constant-pressure expansion valve.
4. Reversing valve.
5. Charge: R-410A.
6. Standard Efficiency minimum 9.2 EER (10.6 SEER).
7. Pre-wired and pre-charged.


1. Access door interlocked disconnect switch.
2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
3. Nickel chrome 80/20 heating elements.
4. Airflow switch for proof of airflow.
5. Fan interlock contacts.
7. Magnetic contactor for each step of control (for three-phase coils).

D. Indoor Fan (Standard Efficiency): Motor, PSC permanently lubricated motor, dynamically balanced blower with resilient motor mounts. Forward curved, centrifugal; with motor and positive-pressure ventilation damper with concealed manual operator.

E. Filters: Filters with filter frame.

F. Condensate Drain: Drain pan to direct condensate to outdoor coil for re-evaporation and piping to direct condensate to building waste and vent piping.

2. Overflow condensate drain to be routed to nearby stand-pipe.

G. Outdoor Fan: Forward curved, centrifugal or propeller type with separate motor.

1. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

   a. Fan Motors: Permanently lubricated split capacitor.
   b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.4 CONTROLS

A. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:

1. Low Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg F outdoor air temperature.
B. Control: Standard unit-mounted controls having adjustable thermostat with heat anticipator, heat-off-cool-auto switch, and on-auto fan switch.

2.5 WARRANTY
A. 5 Year limited warranty on all parts.

2.6 CAPACITIES AND CHARACTERISTICS
A. See Plans.

2.7 SOURCE QUALITY CONTROL
A. Sound-Power Level Ratings: Factory test to comply with ARI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."
B. Unit Performance Ratings: Factory test to comply with ARI 310/380/CSA C744, "Packaged Terminal Air-Conditioners.

2.8 SEISMIC-RESTRAINT DEVICES
A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined:
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.
D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections.
E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.9 WARRANTY
A. 5 Year limited warranty on all parts.
B. 20 year warranty on stainless steel heat exchanger.

2.10 CAPACITIES AND CHARACTERISTICS
A. See Plans.

2.11 SOURCE QUALITY CONTROL
A. Sound-Power Level Ratings: Factory test to comply with ARI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."
B. Unit Performance Ratings: Factory test to comply with ARI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

2.12 EXECUTION

2.13 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.

B. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."

C. Install and anchor wall sleeves to withstand, without damage to equipment and structure, seismic forces required by building code.

2.14 CONNECTIONS

A. Install piping adjacent to machine to allow service and maintenance.

2.15 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. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing packaged terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Packaged terminal air conditioners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

2.16 STARTUP SERVICE

A. After installation, verify the following:

1. Unit is level on base and is flashed in exterior wall.
2. Unit casing has no visible damage.
3. Compressor, air-cooled condenser coil, and fans have no visible damage.
4. Labels are clearly visible.
5. Controls are connected and operable.
6. Shipping bolts, blocks, and tie-down straps are removed.
7. Filters are installed and clean.
8. Drain pan and drain line are installed correctly.
9. Electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

10. Installation. Perform startup checks according to manufacturer's written instructions, including the following:
   a. Lubricate bearings on fan.
   b. Check fan-wheel rotation for correct direction without vibration and binding.

B. After startup service and performance test, change filters.

2.17 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

2.18 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged terminal air conditioners. Refer to Division 1 Section "Closeout Procedures and Demonstration and Training."

END OF SECTION 238113
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. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
5. Common electrical installation requirements.

1.3 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate installation of required supporting devices, sleeves and other electrical devices in precast concrete panels.
1. Coordinate exact locations of all precast construction with Architect and Construction Manager.
2. Coordinate exact mounting locations and mounting heights of all electrical devices to be mounted in precast construction with Architect.
3. Provide recessed boxes (interior and exterior), cabinets and concealed conduits within precast construction. Provide proper coordination with precast manufacturer. Install all boxes and conduits in the precast panel forms at the precast manufacturer's facility as required.
4. Provide written confirmation to the precast manufacturer that all boxes and conduit have been installed, and installed in the correct locations prior to the fabrication of the precast panels.

D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

E. Coordinate sleeve selection and installation with firestopping as specified in Division 7 Section "Through-Penetration Firestop Systems."

F. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS
2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM (Ethylene-propylene-diene terpolymer rubber) interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   3. Pressure Plates: Stainless steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION


B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom.

D. Equipment: Install to facilitate ease of service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Make connections so as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Coordination: Coordinate electrical work with work of other divisions. If code required clearances in front of, above or around electrical equipment cannot be maintained due to installation of equipment, pipes, or ductwork of other division, notify Architect prior to the installation of electrical equipment.
F. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Where through-wall pipe sleeves are shown on plans in vicinity of cable tray, extend sleeve to within one foot horizontally of cable tray.

D. Locate through-wall sleeves in joist space unless otherwise indicated.

E. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies, unless openings compatible with firestop system are fabricated during construction of floor or wall.

G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use 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.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION 260500
SECTION 260519
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. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

   B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. General Cable Corporation.
   5. Alcan Products Corporation; Alcan Cable Division.

B. Copper and Aluminum Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, XHHW, UF, USE and SO.

D. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC; metal-clad cable, Type MC; mineral-insulated, metal-sheathed cable, Type MI; nonmetallic-sheathed cable, Type NM; Type SO; Type USE with ground wire.

2.2 CONNECTORS AND SPLICES

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. AFC Cable Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
   1. Aluminum conductors shall not be used for individual feeders to cycling loads such as elevators, motors, compressors, electric heating equipment, etc.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway; Type XHHW, single conductors in raceway; Mineral-insulated, metal-sheathed cable, Type MI; Type SE or USE multiconductor cable.

B. Exposed Feeders in Finished Public Spaces, Including Units: Type THHN-THWN, single conductors in raceway, with raceway painted to match ceiling, unless explicitly allowed otherwise by the Architect.

C. Exposed Feeders in Other Spaces: Type THHN-THWN, single conductors in raceway; Armored cable, Type AC; Metal-clad cable, Type MC; Mineral-insulated, metal-sheathed cable, Type MI; Nonmetallic-sheathed cable, Type NM.

D. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway; Armored cable, Type AC; Metal-clad cable, Type MC; Mineral-insulated, metal-sheathed cable, Type MI; Nonmetallic-sheathed cable, Type NM.

E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway; Underground feeder cable, Type UF.

F. Exposed Branch Circuits in Finished Public Spaces, Including Units: Type THHN-THWN, single conductors in raceway, with raceway painted to match ceiling, unless explicitly allowed otherwise by the Architect.

G. Exposed Branch Circuits in Other Spaces: Type THHN-THWN, single conductors in raceway; Armored cable, Type AC; Metal-clad cable, Type MC; Mineral-insulated, metal-sheathed cable, Type MI; Nonmetallic-sheathed cable, Type NM.

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway; Armored cable, Type AC; Metal-clad cable, Type MC; Mineral-insulated, metal-sheathed cable, Type MI; Nonmetallic-sheathed cable, Type NM.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway; Underground branch-circuit cable, Type UF.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

M. Lay-in Light Fixture Whips: Hospital grade armored cable, Type AC; Hospital grade metal-clad cable, Type MC
3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible. In finished areas where MC/AC cables are exposed, cables to be neatly bundles with no slack.

E. Paint all exposed MC/AC cabling. Coordinate with architect on exact finish.

F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

G. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

H. Lighting and receptacles shall be on separate branch circuits.

I. Provide separate neutral for individual 20A/1P branch circuits. Sharing neutrals is not allowed. The use of multi-wire branch circuits with a common neutral feeding loads is not allowed.

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 and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

END OF SECTION 260519
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 methods and materials for grounding systems and equipment, plus the following special applications:
   1. Bonding of pool equipment and associated electrical systems.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: As allowed by applicable Codes and authorities having jurisdiction.

B. Bare Copper Conductors:
   4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory 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, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

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

A. Ground Rods: Copper-clad steel, sectional type; 5/8 by 96 inches in diameter.

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. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. 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 Structural Steel: Welded connectors.

3.2 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.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
G. Pools and Sauna: Provide grounding per NFPA 70. Provide corrosion proof equipment for all electrical equipment located with pools, pool mechanical room and sauna.

3.3 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.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

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 so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, 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. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

F. Bond all metallic parts in and on the pool and sauna to the metal reinforcing bars imbedded in the concrete walls of the pool and sauna structure using a solid copper #8 AWG conductor. Provide exothermic or listed pressure clamps. Metallic parts of the pool and/or sauna include, but are not limited to the following: metal fittings, floor drains, metal piping, pool drains, hand rails, metal gutter, water, slider tower, water slide supports, handicapped lights, posts, stanchions, and metal anchors. Metal parts smaller than 4” length in any dimension and imbedded less than 1” in to the pool structure do not need to be bonded. Refer to Aquatics Drawings for additional information and details.

G. Bond all metallic equipment located within 5 feet around the perimeter of the pool and sauna to the metal reinforcing bars imbedded in the concrete wall of the pool and sauna structure using a solid copper #8 AWG conductor. Provide exothermic or listed pressure clamps. Metallic parts around and/or the pool may include, but are not limited to the following: metal portion of fixed seating, door and window frames, metal gates and fences, floor drains and hand rails.
H. Provide corrosion proof equipment (including anchoring equipment, hardware, fittings, coverplates, etc.) for all electrical equipment located within the pool, pool mechanical room, and sauna. Provide non-ferrous stainless steel 304 grade or better or aluminum equipment. Ferrous metal equipment is not allowed.

END OF SECTION 260526
SECTION 260529
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.
   2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.4 QUALITY ASSURANCE

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

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
C. Provide corrosion proof equipment (including anchoring equipment, hardware, fittings, coverplates, etc.) for all electrical equipment located within the pool, pool mechanical room, and sauna. Provide non-ferrous stainless steel 304 grade or better or aluminum equipment. Ferrous metal equipment is not allowed.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Painted Coatings: Manufacturer’s standard painted coating applied according to MFMA-4.
4. 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 hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. 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.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.

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 scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in 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 or other 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 clamps approved for the application.

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: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   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 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 260529
SECTION 260533
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.
B. Refer to 262726 Wiring Devices for floor boxes and surface-mounted multi-outlet assemblies.

1.2 SUMMARY
A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. ENT: Electrical nonmetallic tubing.
C. EPDM: Ethylene-propylene-diene terpolymer rubber.
D. FMC: Flexible metal conduit.
E. IMC: Intermediate metal conduit.
F. LFMC: Liquidtight flexible metal conduit.
G. LFNC: Liquidtight flexible nonmetallic conduit.
H. NBR: Acrylonitrile-butadiene rubber.
I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING
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. AFC Cable Systems, Inc.
   2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
7. Maverick Tube Corporation.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit or IMC.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch, minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   2. Fittings for EMT: Steel or die-cast, set-screw or compression type.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

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 Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. EGS/Appleton Electric.
   7. RACO; a Hubbell Company.
   10. Spring City Electrical Manufacturing Company.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

G. Hinged-Cover Enclosures: 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.

H. 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.
   5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: Rigid steel conduit.
   2. Concealed Conduit, Aboveground: Rigid steel conduit; IMC; EMT; 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. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage:
      a. Type EPC-40-PVC or rigid aluminum conduit.
      b. Rigid aluminum conduit.
      c. Other Areas: EMT.
   2. Exposed, Not Subject to Severe Physical Damage:
      a. Type EPC-40-PVC or rigid aluminum conduit.
      b. Rigid aluminum conduit.
      c. Other Areas: EMT.
   3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:
      a. Loading dock.
      b. Areas used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. In parking garage and other vehicular areas below 7'-0".
   4. Concealed in Ceilings and Interior Walls and Partitions:
      a. Type EPC-80-PVC.
      b. Other Areas: 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. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment):
      a. LFMC in damp or wet locations.
      b. FMC in other areas.
   7. Damp or Wet Locations:
      a. Rigid steel conduit or IMC in other areas.
b. Rigid aluminum conduit in pools, pool mechanical room, saunas, and spas.

8. 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.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

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. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated. Coordinate with precast concrete panel manufacturer as required, see Division 26 Section “Common Work Result for Electrical”.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
   4. In post-tension slabs do not embed conduits greater than 1-inch trade size prior to coordination with structural engineer.

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. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. 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.

L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
   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 the Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
2. 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.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

N. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit forequipment 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 or LFNC in damp or wet locations not subject to severe physical damage.

O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

P. Install exposed receptacles in cast metal boxes. Locate receptacles in web of columns or in locations where the receptacle is protected from damage.

Q. Exposed sheet metal boxes are prohibited.

R. All conduits associated with rooftop mechanical units shall penetrate roof within equipment curb.

S. Do not install raceway in stairwells that is not required for equipment located in stairwell.

T. Paint all exposed conduits and boxes. Coordinate with architect on exact finish color.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
1. 90 and 45 degree elbows to be manufactured galvanized rigid steel conduit elbows with long radius bends.
2. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
3. Install backfill as specified in Division 31 Section "Earth Moving."
4. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
5. Provide elbows for stub-ups at poles and equipment and at building entrances through the floor.
   a. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.
7. Install pull cords in empty conduits.

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533
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. Identification for conductors.
   2. Underground-line warning tape.
   3. Warning labels and signs.
   4. Instruction signs.
   5. Equipment identification labels.

1.3 QUALITY ASSURANCE

B. Comply with NFPA 70.
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 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.2 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, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Requirements:
1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils.
3. Weight: 18.5 lb/1000 sq. ft.
4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

2.3 WARNING LABELS AND SIGNS


B. Baked-Enamel Warning Signs:
1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

C. Metal-Backed, Butyrate Warning Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning:
   a. "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   b. Locate at all equipment fed from multiple power sources, including transfer switches.

2. Workspace Clearance Warning:
   a. "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES."
   b. Locate at all panelboards, switchboards, transformers, enclosures, etc.
   c. Contractor to revise clearance area as necessary to meet NEC Table 110.26(A)(1).

3. Series Rated Equipment:
   a. "CAUTION – SERIES COMBINATION SYSTEM RATED _________ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED."
   b. Locate at all equipment that is scheduled as series rated.
   c. Contractor to revise amperage as necessary to meet NEC 110.22.

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
2.5 EQUIPMENT IDENTIFICATION LABELS


B. For exterior equipment: Stenciled Legend in nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
   2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F.
   5. Color: Black.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

H. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 30-foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
   2. Power.
   3. UPS.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
   1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
      a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
      b. Colors for 208/120-V Circuits:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.
      c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
   1. Limit use of underground-line warning tape to direct-buried cables.
   2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.

H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer.

J. 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: 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 engraved, laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Access doors and panels for concealed electrical items.
      d. Switchboards.
      e. Emergency system boxes and enclosures.
      f. Enclosed switches.
      g. Enclosed circuit breakers.
      h. Enclosed controllers.
      i. Variable-speed controllers, including those provided by other disciplines.
      j. Push-button stations.
      k. Power transfer equipment.
      l. Contactors.
      m. Remote-controlled switches, dimmer modules, and control devices.
      n. Power-generating units.
      o. Monitoring and control equipment.

K. Provide placard of master legend indicating pipe and wire type corresponding to the color codes in this section. Mount in electrical room.

END OF SECTION 260553
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.

B. Refer to 262726 Wiring Devices for device colors and wall plate requirements.

1.2 SUMMARY

A. This Section includes the following lighting control devices:
   1. Snap switches.
   2. Wall box dimmers.
   3. Indoor occupancy sensors.
   4. Lighting contactors.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

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

B. Field quality-control test reports.

C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 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.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switch ratings: 120/277 V, 15 or 20 A:

C. Switches:
   1. Products: Subject to compliance with requirements, provide one of the following:
a. Cooper (white); 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
b. Hubbell (white); CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
c. Leviton (white); 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
d. Pass & Seymour (white); 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.2 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Lighting.
   3. Lithonia Lighting; Acuity Lighting Group, Inc.
   4. Novitas, Inc.
   5. RAB Lighting, Inc.
   6. Sensor Switch, Inc.
   7. TORK.
   8. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
   1. Operation shall be as follows (unless otherwise indicated):
      a. Ceiling units: See ceiling occupancy table on plans.
      b. Wall units: Only manual operation shall turn lights on. Sensor operation shall turn lights off when unoccupied. Sensor shall have a time delay, adjustable over a minimum range of 1 to 15 minutes, initially set at 15 minutes.
   2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
   4. Mounting:
      a. Sensor: Suitable for mounting in any position on a standard outlet box.
      b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
      c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door. Default time delay to be 15 minutes.
   5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
   6. Bypass Switch: Override the on function in case of sensor failure.
   7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
   1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
   2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
   1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
   2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.3 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
   4. GE Industrial Systems; Total Lighting Control.
   5. Grasslin Controls Corporation; a GE Industrial Systems Company.
   6. Hubbell Lighting.
   7. Lithonia Lighting; Acuity Lighting Group, Inc.
   9. Square D; Schneider Electric.
  10. TORK.
  11. Touch-Plate, Inc.
  12. Watt Stopper (The).

B. Description: Electrically operated and electrically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
   2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
   3. Enclosure: Comply with NEMA 250.
   4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.4 DEVICE COLORS AND WALL PLATES

A. Provide device colors and wall plates as specified in 262726 Wiring Devices.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION
A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION
A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION
A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION
A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
B. Label time switches and contactors with a unique designation.

3.5 ADJUSTING
A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 260923
SECTION 262416
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. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.
   3. Load centers.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices, where applicable.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.
   8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Operation and Maintenance Data: For panelboards and components 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. 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.

1.4 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.
1.5 DELIVERY, STORAGE, AND HANDLING
A. Remove loose packing and flammable materials from inside panelboards; if storage conditions require it install temporary electric heating (250 W per panelboard) to prevent condensation.
B. Handle and prepare panelboards for installation according to NECA 407.

1.6 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:
         1) For panels with fused switches: Not exceeding minus 22 deg F to plus 104 deg F.
         2) For panels with circuit breakers: Not exceeding 23 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.

1.7 COORDINATION
A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 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.

1.9 EXTRA MATERIALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Two spares for each type of panelboard cabinet lock.
   2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
   3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
      e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
   2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
   3. Finishes:
      a. Panels and Trim: Steel or 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: Same finish as panels and trim.

B. Incoming Mains Location: Top or bottom (contractor's discretion).

C. Phase, Neutral, and Ground Buses:
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
   3. Neutral Bus:
      a. Normally rated 100 percent of phase bus.
      b. Extra-Capacity Neutral Bus (where indicated): Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

D. Conductor Connectors: Suitable for use with conductor material and sizes.
   2. Main and Neutral Lugs: Mechanical type.
   3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
   4. Feed-Through Lugs (where indicated): Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   5. Subfeed (Double) Lugs (where indicated): Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

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. Only applicable to panels used as service entrance equipment, coordinate with plans.

F. Future Devices (where indicated): Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating:
   1. Fully rated to interrupt symmetrical short-circuit current available at terminals.
   2. Where indicated as series rated, panel shall be rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.
H. Multiwire Disconnecting Means:
   1. Provide each multiwire branch circuit with a means that will simultaneously disconnect all
      ungrounded conductors at the point where the branch circuit originates.

I. To be compatible with aluminum feeders.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the
   following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Mains (as indicated on drawings): Circuit breaker, fused switch, or lugs only.

D. Branch Overcurrent Protective Devices (as indicated on drawings):
   1. Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device
      requires mechanical release for removal.
   2. Fused switches.

2.3 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.
   4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains (as indicated on Drawings): Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing
   adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with
   same short-circuit interrupting rating as panelboard.
   1. Internal Control-Power Source: Control-power transformer, with fused primary and
      secondary terminals, connected to main bus ahead of contactor connection.

F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

G. Column-Type Panelboards (where indicated): Narrow gutter extension, with cover, to overhead
   junction box equipped with ground and neutral terminal buses.

2.4 LOAD CENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the
   following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.
B. Load Centers: Comply with UL 67.

C. Mains (as indicated on Drawings): Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices:
   1. For breakers serving general lighting and receptacle loads per NEC 210.12:
   2. For breakers serving appliances, dedicated equipment, and bathrooms:
      a. Plug-in circuit breakers, replaceable without disturbing adjacent units.

E. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.5 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.
   4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB) (where indicated): Comply with UL 489, with interrupting capacity to meet available fault currents. Series rating is allowed where indicated on plans.
   3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and \( I^2t \) response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
      d. Ground-Fault Protection (where indicated): Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      e. Shunt Trip (where indicated): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
      f. Undervoltage Trip (where indicated): Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
g. Auxiliary Contacts (where indicated): One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.

h. Alarm Switch (where indicated): Single-pole, normally open contact that actuates only when circuit breaker trips.

i. Key Interlock Kit (where indicated): Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

j. Zone-Selective Interlocking (where indicated): Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.

k. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

l. Handle Padlocking Device (where indicated): Fixed attachment, for locking circuit-breaker handle in on or off position.

m. Handle Clamp (where indicated): Loose attachment, for holding circuit-breaker handle in on position.

n. Provide lock and clip-on fire alarm panel circuit breakers, security, and other essential load circuit breakers.

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 Division 26 Section "Fuses."
   2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
   3. Auxiliary Contacts (where indicated): One 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. Equipment Mounting: Install floor-mounted panelboards on concrete bases, 6-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
   2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to panelboards.
   5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
D. Mount top of trim 90 inches above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.  
   1. Set field-adjustable, circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. For flush-mounted panel, stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.  Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Panelboard Directories:  
   1. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations.  
   2. Obtain approval before installing.  
   3. Use a computer or typewriter to create directory; handwritten directories are not acceptable.  
   4. Label spares as such.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates:  
   1. Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems." Label spares as such.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

3.6 PROTECTION

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

END OF SECTION 262416
SECTION 262726
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.

B. Refer to 260923 Lighting Control Devices for snap switches, occupancy sensors and wall box dimmers.

1.2 SUMMARY

A. This Section includes the following:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Communications outlets.
   3. Floor boxes and poke-through assemblies and multioutlet assemblies.

1.3 SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers’ packing label warnings and instruction manuals that include labeling conditions.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
   1. Cord and Plug Sets: Match equipment requirements.

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; a division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

B. All catalog numbers refer to 20A devices. If devices of differing amperages are specified it is contractor’s responsibility to verify correct catalog number.
2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 15 or 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 5351 (single), 5352 (duplex).
      b. Hubbell; HBL5351 (single), CR5352 (duplex).
      c. Leviton; 5891 (single), 5352 (duplex).
      d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Tamper-Resistant Convenience Receptacles, 125 V, 15 or 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; TR8300.
      b. Hubbell; HBL8300SG.
      c. Leviton; 8300-SGG.
      d. Pass & Seymour; 63H.
   2. Description: Labeled to comply with NFPA 70, “Health Care Facilities” Article, “Pediatric Locations” Section.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; GF20.
      b. Pass & Seymour; 2084.

2.4 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
   1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2.5 COMMUNICATIONS OUTLETS

A. Verify exact device requirements with Owner.

B. Telephone Outlet:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 3560-6.
      b. Leviton; 40649.
   2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

C. Combination TV and Telephone Outlet:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Cooper; 3562.
      b. Leviton; 40595.
   2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.
2.6 FLOOR BOXES AND POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Incorporated; Wiring Device-Kellems.
   2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
   3. Square D/ Schneider Electric.
   4. Thomas & Betts Corporation.
   5. Wiremold Company (The).

B. Poke-Through Assemblies:
   1. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
   2. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks.
   3. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
   4. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
   5. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
   6. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, 4-pair, Category 5e voice and data communication cables.

2.7 MULTIOUTLET ASSEMBLIES

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. Hubbell Incorporated; Wiring Device-Kellems.
   2. Wiremold Company (The).

B. Components of Assemblies:
   1. Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
   2. Provide power receptacles (NEMA WD 6 configuration 5-20R) on 36” centers unless otherwise noted.
   3. Provide channel for communication wiring, with blanks on 36” centers for device installation by others.

C. Raceway Material: PVC.

D. Wire: No. 12 AWG.

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
   1. Wiring Devices: White, unless otherwise indicated or required by NFPA 70 or device listing.

2.9 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Common areas (Lobby, Corridors, Leasing, Fitness, etc): 0.035-inch- thick, satin-finished stainless steel.
   3. Material for Units: Smooth, high-impact thermoplastic.
   5. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."
B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
   1. Take steps to insure that devices and their boxes are protected. 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 the 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 just 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 pigtailes.
   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 all devices that have been in temporary use during construction or that show signs that they 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 pigtailes 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, 2/3 to 3/4 of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
   7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtailes 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. 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.

F. Arrangement of Devices:
   1. Receptacle Orientation: Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
   2. Unless otherwise indicated, mount flush, with long dimension vertical.
   3. Group adjacent devices under single, multigang wall plates.
G. Adjust locations of service poles to suit arrangement of partitions and furnishings.

H. Tamper-Resistant Receptacles: Within dwelling units all 15A and 20A single-pole receptacles shall be tamper-resistant. Includes receptacles located at exterior patio, balcony, etc.
   1. Exceptions:
      a. Receptacles part of a luminaire or appliance.
      b. Receptacles dedicated for large or fixed appliances or equipment.
      c. Mounted within cabinets or cupboards.
      d. Mounted more than 66” above the floor.

I. Floor Boxes and Poke Through Assemblies:
   1. Request dimensioning from architect/engineer prior to installation.
   2. Set metal floor boxes level and flush with finished floor surface.
   3. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
   1. Receptacles: Identify panelboard and circuit number from which served.

END OF SECTION 262726
SECTION 262813
FUSES

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. Section Includes:
1. Cartridge fuses rated 600-V ac and less for use in switches, panelboards, switchboards and enclosed controllers.
2. Spare-fuse cabinets.

1.3 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.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, 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.
1.5 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.

1.6 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.

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 L, time delay.
   2. Feeders: Class RK1, time delay.
   3. Motor Branch Circuits: Class RK5, time delay.
   4. 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(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Electrical Identification" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813
SECTION 262816
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. Molded-case circuit breakers (MCCBs).
   5. Molded-case switches.

1.3 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. NC: Normally closed (“form B”).

C. NO: Normally open (“form A”).

D. SPDT: Single pole, double throw (“form C”).


F. NRTL: Nationally Recognized Testing Laboratory (i.e. UL or ETL).

G. SCIR: Short-circuit interrupting rating (i.e. kAIC kiloamperes interrupting capacity).

H. SCCR: Short-circuit current rating (i.e. withstand rating).

1.4 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.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of NRTL listing for series rating of installed devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Operation and Maintenance Data: For enclosed switches and circuit breakers 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. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 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.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

1.7 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.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. 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.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Midwest Power (A.M.P. Manufacturing and Supply)
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   5. Square D; a brand of Schneider Electric.
   6. States Electric

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate indicated fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
C. Type HD, Heavy Duty, Single Throw, 600-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.

D. 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. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Midwest Power (A.M.P. Manufacturing and Supply)
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
5. Square D; a brand of Schneider Electric.
6. States Electric

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. 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. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

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 for Elevator Shunt Trip Switches: 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. Oiltight key switch for key-to-test function.
   2. Oiltight ON pilot light.
   3. Isolated neutral lug; 200 percent rating.
   4. For use with hydraulic elevators with automatic recall: Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
   5. Form C alarm contacts that change state when switch is tripped.
   6. For use when interfacing elevators with facility fire-alarm system is required:
      a. Three-pole, double-throw, fire-safety and alarm relay; 24-V dc coil voltage.
      b. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Midwest Power (A.M.P. Manufacturing and Supply)
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   5. Square D: a brand of Schneider Electric.
   6. States Electric

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.


D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I²t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.5 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Midwest Power (A.M.P. Manufacturing and Supply)
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   5. Square D; a brand of Schneider Electric.
   6. States Electric

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:
   1. Standard frame sizes and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

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. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.
D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified.

END OF SECTION 262816
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 ac, enclosed controllers rated 600 V and less, of the following types:
   1. Across-the-line, manual and magnetic controllers.
   2. Power Module Switches for elevators.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current rating of integrated unit.
      d. UL listing for series rating of overcurrent protective devices in combination controllers.
      e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
   2. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Qualification Data: For manufacturer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For enclosed controllers to include in operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
   1. Routine maintenance requirements for enclosed controllers and all installed components.
   2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.
1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

C. 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.

D. Comply with NFPA 70.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

C. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.7 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. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.

2. Indicating Lights: Two of each type installed.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   4. Square D/Group Schneider.

B. Power Module Switch
   1. Bussman (no substitution)

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS


B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
   1. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
   2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 10 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.
   1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.

2.3 POWER MODULE SWITCHES

A. Description: Surface-mounting cabinets. NEMA 250, Type 1.

B. 600 VAC, 3 pole, 200 amp, fused power switch, 200,000 amp RMS short-circuit current rated with integral 120 volt shunt trip, 100 VA control power transformer and terminal block, ground lug, and for use with Class J fuses. Provide with the following:
   1. Class J fuses sized per elevator supplier requirements.
   2. Fire safety, fire alarm system compatible, interface relay. Provide 24 volt DC or 120 volt as required to interface with Fire Alarm devices and system.
   4. Mechanically interlocked auxiliary contact for hydraulic elevator with battery backup, 5 amp and 120 volt rated.
   5. Fire Alarm voltage monitoring relay to monitor shunt trip voltage.

2.4 ENCLOSURES

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2.5 ACCESSORIES
A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
B. Selector Switches (HOA) and Pilot Lights: NEMA ICS 2, heavy-duty type.
C. Control Relays: Auxiliary and adjustable time-delay relays.
D. Pilot Lights: Green “On/Running”.

2.6 FACTORY FINISHES
A. Finish: Manufacturer’s standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION
3.1 EXAMINATION
A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS
A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.
B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION
A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Electrical Supports."
B. Install freestanding equipment on concrete bases.
C. Comply with mounting and anchoring requirements specified in Division 26 Section "Electrical Supports."
D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 CONCRETE BASES
A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
B. Concrete base is specified in Division 26 Section "Electrical Supports," and concrete materials and installation requirements are specified in Division 3.

3.5 IDENTIFICATION
A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."
3.6 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
   1. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.8 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Manufacturer’s Field Service: Engage a factory-authorized service representative to perform the following:
   1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

A. Set field-adjustable overloads, switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 262913
SECTION 265100
INTERIOR LIGHTING

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. Interior lighting fixtures, lamps, and ballasts.
   2. Emergency lighting units.
   3. Exit signs.
   4. Lighting fixture supports.
   5. Lighting rebate program.

B. Battery exit, battery emergency, and quartz re-strike fixtures are listed in this section but not necessarily used on project. See Luminaire Schedule on drawings to determine battery requirements or connection to emergency generator.

C. Related Sections include the following:
   1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
   2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. Emergency lighting units including battery and charger.
   5. Life, output, and energy-efficiency data for lamps.
   6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
      a. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

D. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
   2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
   2. Warranty Period for Electromagnetic Ballasts: Three Insert number years from date of Substantial Completion.

C. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: Two year(s) from date of Substantial Completion.

1.7 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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Battery and Charger Data: One for each emergency lighting unit.
   4. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
   5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. See lighting schedule on plans.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. LED Fixtures: Comply with UL and NEMA standards.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
      b. UV stabilized.
   2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 LUMINAIRE REQUIREMENTS

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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598.

E. Lamp base complying with ANSI C81.61.

F. Bulb shape complying with ANSI C79.1.

G. CRI of 80. CCT of 000 K.

H. L70 lamp life of 50,000 hours.
I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

J. Internal driver.

K. Nominal Operating Voltage: 120 V ac or 277 V ac.

L. In-line Fusing: On the primary for each luminaire.

M. Lamp Rating: Lamp marked for location.

N. Source Limitations: Obtain luminaires from single source from a single manufacturer.

O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.4 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
   1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
   2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
      a. Battery: Sealed, maintenance-free, nickel-cadmium type.
      b. Charger: Fully automatic, solid-state type with sealed transfer relay.
      c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
      d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
      f. Integral Self-Test (if indicated on schedule): provide factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.5 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.
   1. Battery: Sealed, maintenance-free, lead-acid type.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   6. Wire Guard (where indicated on plan): Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Self-Test (if indicated on schedule): Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.6 **LIGHTING FIXTURE SUPPORT COMPONENTS**

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.


E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.7 **LIGHTING REBATE PROGRAM**

A. Provide documentation as required related to energy rebate.

**PART 3 - EXECUTION**

3.1 **INSTALLATION**

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. In mechanical rooms, janitor's closets, data rooms, etc. fixture locations are approximate. Field coordinate with other trades as required.

C. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings:
   1. Light fixtures shall not be supported from the suspended ceiling grid. Fixtures shall be supported from the building structure.
   2. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
   3. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   4. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

D. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

E. Adjust aimable lighting fixtures to provide required light intensities.

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
G. Clean fixture lenses and reflectors that have visibly accumulated dirt, dust or debris. Use cleaning solutions and methods as recommended by manufacturer to avoid streaking, scratching and static.

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100
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. Removing above- and below-grade site improvements.
   2. Disconnecting, capping or sealing, and abandoning site utilities in place removing site utilities.
   3. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:
   1. Section 015000 - Temporary Facilities
   2. Section 312000 - Earth Moving

1.3 MATERIAL OWNERSHIP
A. Cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 PROJECT CONDITIONS
A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.
PART 2 - PRODUCTS (Not Applicable)

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.4 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
   1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION
SECTION 312000
EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Special Provisions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Preparing and grading subgrades for slabs-on-grade, walks and landscaping.
   2. Subbase course for walks and pavements.

B. Related Sections: The following Sections contain requirements that relate to this Section.
   1. Section 015000 - Temporary Facilities
   2. Section 311000 - Site Clearing
   3. Section 321210 - Aggregate Base Course
   4. Section 321313 - Portland Cement Concrete Paving
   5. Section 334100 - Storm Sewerage

1.3 UNIT PRICES

A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:
   1. 24 inches (600 mm) outside of concrete forms other than at footings.
   2. 12 inches (300 mm) outside of concrete forms at footings.
   3. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
   4. To subgrade of concrete slabs on grade, subbase or drainage fill.

1.4 DEFINITIONS

A. Excavation: The removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.

B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

D. Aggregate Base Course: The layer placed between the subbase and surface pavement in a paving system.

E. Drainage Fill: Course washed granular material supporting slab-on-grade or adjacent to structures placed to collect and direct capillary flow of water.
F. Unauthorized Excavation: The removing of materials beyond indicated subgrade elevations or dimensions without approval by the Engineer. Unauthorized excavation, as well as remedial work approved by the Engineer, shall be at the Contractor's expense.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

H. Utilities: Include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Comply with requirements of the following specifications as modified herein.
   1. Illinois Department of Transportation, Current Edition
      a. Standard Specifications for Road and Bridge Construction
      b. Supplemental Specifications and Recurring Special Provisions
      c. References to sections on measurement and basis of payment shall not apply
   2. U.S. Department of Transportation Federal Highway Administration

1.6 PROJECT CONDITIONS

A. Coordinate with other work.

B. Protect and maintain existing utilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sub-base or Base Material: CA 6 or CA 10.


C. Engineered Fill: Sub-base or base material.
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide 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.

3.2 DEWATERING

A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.3 CONSTRUCTION REQUIREMENTS

A. Construction shall be per the plans, the above referenced Specifications, and as modified below.

3.4 EXCAVATION

A. Explosives: Use of explosives will not be permitted.

B. Classified Excavation: Excavation is classified and includes excavation to required subgrade elevations. Excavation will be classified as earth excavation or rock excavation as follows:
   1. Earth excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with soil and other materials encountered that are not classified as rock or unauthorized excavation.
      a. Intermittent drilling, blasting, or ripping to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
   2. Rock excavation includes removal and disposal of rock material and obstructions encountered which, in the opinion of the Engineer, require for its removal the continuous use of pneumatic tools or drilling and blasting.
      a. Rock material includes boulders 1/2 cu. yd. (0.38 cu. meter) or more in volume and rock in beds, ledges, unstratified masses, and conglomerate deposits.
      b. The Contractor shall be required to demonstrate that the material cannot be removed "by hand pick" or by a power operated excavator or shovel of at least 3/4 cubic yard (0.57 cubic meter) capacity, which is in good working condition. No payment will be made for Rock Excavation unless air tools or explosives were used by the Contractor.
      c. No payment will be made for Rock Excavation unless the Engineer approves such payment in writing in advance upon being satisfied that the material meets the above criteria.
C. Excavate surfaces under walks, gravel areas, slab on grade, and pavement to indicated lines, cross sections, elevations, and subgrades. Prepare subgrade in accordance with Section 301 of the IDOT Standard Specification which includes disking 3 consecutive days for drying.

3.5 APPROVAL OF SUBGRADE

A. The contractor shall be required to strip a minimum of 6 inches of topsoil within the proposed pavement area and designated areas prior to any grading operations. All topsoil shall be stockpiled for use elsewhere on the site or removed from site entirely. All vegetation, rocks (3 inches or larger), debris, etc. shall be disposed of.

B. The contractor shall be required to provide adequate drainage by temporary ditches, temporary culverts, mechanical pumping or whatever means necessary to prevent water from ponding for extended periods of time in the pavement sub-grade.

C. Compact the top 12 inches below sub grade and each layer of backfill or fill material at 98 percent maximum dry density according to ASTM D698 (Standard Proctor).

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as approved by the Engineer.

E. Test rolling of subgrade for pavement.
   1. The Contractor shall provide, at his own expense, a loaded truck and test roll the compacted earth subgrade in the presence of the Engineer or the Engineer's representative before any subbase, base or surface material is placed. The Contractor shall provide the Engineer a minimum 48-hour notice prior to test rolling.
   2. The Contractor shall also provide the local Municipality's representative a minimum 48-hour notice prior to test rolling if so required by the Municipality.
   3. The truck shall be loaded as follows: 27,000 pounds (12,250 kilograms) on two axles and 45,000 pounds (20,400 kilograms) on three axles with a tolerance not to exceed 10 percent.
   4. The truck shall make one pass over the entire subgrade area to be constructed. Any areas that show rutting, cracking or rolling of the compacted subgrade upon test rolling will not be accepted. The Contractor shall re-compact and/or reconstruct the section that fails and test roll again prior to acceptance.
   5. Repairs and/or reconstruction of subgrade will be paid according to the contract provisions for Extra Work.

F. If adequate compaction is not achieved after initial grading, the contractor shall be required, as part of this contract, to disc and work the sub-grade to a minimum depth of 12 inches for no less than 3 consecutive days in relatively warm, dry weather.

G. Final compaction approval shall be the opinion of the Owner's representative and geotechnical consultant hired by the Contractor to perform compaction testing.

H. Acceptable subgrade repair methods:
   1. Remove unsatisfactory subgrade and replace with oversized rock or CA-6 as directed by the geotechnical consultant. The depth of unsatisfactory subgrade removal & replacement shall be determined in accordance with the Illinois Department of Transportation Subgrade Stability Manual.
   2. Stabilize subgrade by lime modification.
3.6 MATERIALS
A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.7 BACKFILL
A. Backfill excavations promptly, but not before completing the following:
   1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, wall bracing and perimeter insulation.
   2. Surveying locations of underground utilities for record documents.
   3. Concrete formwork removal.
   4. Removal of trash and debris from excavation.
   5. Removal of temporary shoring and bracing, and sheeting.

3.8 COMPACTION
A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.
B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
C. Percentage of Maximum Dry Density Requirements: Compact soil in accordance with soils report. In lieu of a soils report, compact soil to not less than the following percentages of maximum dry density according to ASTM D 698: (standard)
   1. Under structures, building slabs, steps, and pavements, compact the top 12 inches (300 mm) below subgrade and each layer of backfill or fill material at 98 percent maximum dry density.
   2. Under walkways, compact the top 6 inches (150 mm) below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.
   3. Adjacent to structures, under lawn or unpaved areas, compact the top 6 inches (150 mm) below subgrade and each layer of backfill or fill material at 90 percent maximum dry density.

3.9 GRADING
A. Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Construct a smooth transition between existing adjacent grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.
B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 0.10 foot (30 mm).
   2. Walks: Plus or minus 0.10 foot (30 mm).
   3. Pavements: Plus or minus 1/2 inch (13 mm).
3.10 FIELD QUALITY CONTROL

A. Construction Observation and Compaction Testing.
   1. The Contractor will provide construction observation and compaction testing through a
      qualified representative or a qualified geotechnical testing company. The Contractor shall
      notify the Owner or the Owner’s representative a minimum of 48 hours prior to any work.
      The Contractor shall not proceed until test results for previously completed work verify
      compliance with requirements.

B. Soils Investigation
   1. The Contractor will provide a qualified geotechnical testing company to classify proposed
      on-site and borrow soils to verify that soils comply with specified requirements and to
      provide a Soils Analysis Report.

3.11 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep
   free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed
   surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction
   operations or weather conditions.
   1. Scarify or remove and replace material to depth approved by the Engineer; reshape and
      re-compact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project correction period, remove finished surfacing,
   backfill with additional approved material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work,
      and eliminate evidence of restoration to the greatest extent possible.

3.12 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated storage areas on the Owner’s property. Stockpile
   or spread soil as directed by Owner’s representative.
   1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose
      of it off the Owner's property.

END OF SECTION
SECTION 321210
AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions, Special Provisions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes provisions for furnishing and placing one or more courses of aggregate on a prepared subgrade or sub-base.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 321210 - Aggregate Base Course
   2. Section 321313 - Portland Cement Concrete Paving

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with requirements of the following specifications as modified herein.

B. Illinois Department of Transportation, Current Edition
   1. Standard Specifications for Road and Bridge Construction
   3. References to sections on measurement and basis of payment shall not apply

C. U.S. Department of Transportation Federal Highway Administration


1.4 PROJECT CONDITIONS

A. Coordinate with other work.

B. Protect and maintain existing utilities.
PART 2 - PRODUCTS

2.1 MATERIALS AND MIXTURES
   A. Aggregate Base Course Type B shall be used.
   B. Gradation: CA 4, CA 6, or CA 10.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS
   A. Construction shall conform to the Plans and the above referenced Specifications.

3.2 PREPARATION
   A. Test roll prepared subgrade surface per Section 312000.

3.3 PLACEMENT
   A. Spreader box will not be required.

3.4 FIELD QUALITY CONTROL
   A. Construction Observation.
      1. The Contractor will provide construction observation and testing through a qualified representative. The Contractor shall notify the Owner or the Owner's representative a minimum of 48 hours prior to any work.

3.5 CLEAN UP
   A. Contractor shall do cleanup on areas as work progresses. Final payment shall not be made until the work areas are restored as required and all wastes and equipment removed. If final cleanup is not done within five (5) days of being requested to do so by the Owner's representative, the Owner may undertake such work and deduct costs from the Contractor retainage.

END OF SECTION
SECTION 321313
PORTLAND CEMENT CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, Special Provisions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes exterior Portland Cement Concrete paving for the following:
   1. Combination concrete curb and gutter, Type B6.18
   2. PCC Sidewalk
   3. PCC Pavement

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 312000 - Earthwork
   2. Section 321210 - Aggregate Base Course

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with requirements of the following specifications as modified herein.
   1. Illinois Department of Transportation, Current Edition
      a. Standard Specifications for Road and Bridge Construction
      b. Supplemental Specifications and Recurring Special Provisions
      c. References to sections on measurement and basis of payment shall not apply
   2. U.S. Department of Transportation Federal Highway Administration

B. Testing and Inspection: The Contractor shall provide testing services, warrant same and supply copies of all test results to the Owner. The Owner will provide intermittent engineering and inspection as Owner feels is necessary.

1.4 PROJECT CONDITIONS

A. Coordinate with other work.

B. Protect and maintain existing utilities.
PART 2 - PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

A. Class SI-3500 psi
   1. Combination concrete curb and gutter, Type B6.18
   2. PCC Sidewalk

2.2 REINFORCEMENT

A. Grade 60

PART 3 - EXECUTION

3.1 PREPARATION

A. Test roll prepared subbase surface per Section 02201.

3.2 PLACEMENT

A. Placement shall be per the plans and the above referenced Standard Specifications for Road and Bridge Construction Sections 420, 423, 424, 606.

3.3 FIELD QUALITY CONTROL

A. Proportioning, Testing and Inspection Service: The Contractor shall provide proportioning, testing and inspection for plant and field, warrant same and supply the Owner with copies of all test results. Field tests shall be performed after any water or other additives are included in the mix in the field.

For Portland Cement Concrete the Contractor shall submit mix designs for all mixtures to be used. Mix design submittals shall include strength reports from recent projects where the mix was previously used. The mix design shall be certified by a P.C. Concrete Level III Technician. The Contractor shall take the following tests in the field each day that twenty cubic yards or more of any mix is being placed.

1. Four test cylinders per every 100 cubic yards per mix placed
2. Air content, one test per every 100 cubic yards per mix placed
3. Slump, one test per every 100 cubic yards per mix placed
4. Concrete tickets shall be given the Owner daily

Test cylinders shall be taken to an independent laboratory and broken at the following intervals: 7-day, 14-day and 28-day. If the Contractor wishes to run tests at earlier intervals in order to drive on the subject concrete early, the Contractor shall take additional cylinders to run said tests. Testing may be performed by a P.C. Concrete Level I Certified Technician but must be verified by a P.C. Concrete Level II Certified Technician.

B. Construction Observation and Inspection: The Owner will provide intermittent construction observation and inspection as Owner feels is necessary
3.4 JOINTS

A. General: Construct contraction, construction, and expansion joints as shown on the drawings and as specified below.

B. Contraction Joints: Construct contraction joints for a depth equal to at least 1/4 of the concrete thickness, as follows:
   1. Tooled Joints: Forming contraction joints in fresh concrete by grooving and finishing each edge of joint with a radiused jointer tool meeting minimum depths will be allowed.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide (3 mm) joints into hardened concrete when cutting action will not tear, abrade, or otherwise damage surface and before development of random contraction cracks.
   3. The sawing of contraction joints shall commence within four hours of the start of the pour unless otherwise approved by the Engineer. Sawing shall continue until all the joints are completed or as otherwise approved by the Engineer.
   4. The Combination Concrete Curb and Gutter shall be sawed or scored at 15 foot (4.5 m) intervals if Bituminous pavement is specified or coinciding with the joint interval of the adjoining pavement if Concrete pavement is specified.
   5. Minimum joint depth of the gutter shall be 2-inch (50 mm) and on the curb shall be 1-inch (25 mm).
   6. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than 1/2 hour, unless paving terminates at expansion joints.
   7. Continue reinforcement across construction joints unless indicated otherwise. Do not continue reinforcement through sides of strip paving unless indicated.
   8. Provide tie bars at sides of paving strips where indicated.

C. Expansion Joints: Form expansion joints of bituminous preformed joint filler strips as shown on the drawings and as specified below:
   1. Locate ½ inch thick (13 mm) expansion joints at intervals of 50 feet (15 m), and between pours in sidewalk, and 1 inch thick (25 mm) at all P.C.’s, P.T.’s, R.P.C.’s and at 500 foot (150 m) maximum intervals in curb and gutter and pavement.
   2. Extend joint fillers full width and depth to one (1) inch (25 mm) below the bottom of pavement. Place top of joint filler flush with finished concrete surface.
   3. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
   4. Protect top edge of joint filler during concrete placement.

3.5 PLACING REINFORCEMENT

A. Existing sidewalk
   1. Thirty-inch long #4 bars shall be doweled into existing sidewalk at 30” centers where new sidewalk meets existing.

3.6 CONCRETE PLACEMENT

A. Trucks and mixer trucks will be allowed to operate on the subgrade; however, should subgrade show any sign of distress, all operations will cease until these items are corrected to the satisfaction of the Engineer. Any subgrade distressed by trucks and mixer trucks shall be repaired at the Contractor's expense. No additional compensation shall be allowed.
B. Adjustment of Frame of Grate: Final grade for all manhole castings will be determined after the curb and gutter has been poured and the subgrade and/or base has been constructed.

3.7 FINISHES

A. Sidewalk

B. Final finish shall be Type B (artificial turf drag) as described in the “Standard Specifications for Road & Bridge Construction”
   1. A burlap drag or light broom finish shall not be allowed.

3.8 CLEAN UP

A. Contractor shall do cleanup on areas as work progresses. Final payment shall not be made until the work areas are restored as required and all wastes and equipment removed. If final cleanup is not done within five (5) days of being requested to do so by the Owner's representative, the Owner may undertake such work and deduct costs from the Contractor retainage.

B. Excess Excavation: All excess excavated materials shall become the responsibility of the Contractor for disposal off the construction site. The Owner reserves the right to have selected excavated materials deposited at designated locations within the Project Limits at no additional cost to the Owner.

END OF SECTION
SECTION 334100
STORM SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes storm sewerage system piping and appurtenances.

B. Related Sections: The following sections contain requirements that relate to this section:
   1. Section 321313 - Concrete Paving

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with requirements of the following specifications as modified herein.
   1. Illinois Department of Transportation, current edition
      a. Standard Specifications for Road and Bridge Construction
      b. Supplemental Specifications and Recurring Special Provisions
      c. References to sections on measurement and basis of payment shall not apply
   2. U.S. Department of Transportation Federal Highway Administration

1.4 PROJECT CONDITIONS

A. Coordinate with other work.

B. Protect and maintain existing utilities.

PART 2 - PRODUCTS

2.1 STORM SEWER

A. Polyvinyl Chloride (PVC) ASTM D 3034 SDR 26; bell and spigot for elastomeric gasket joints, minimum cell class 12454 B or C.
   1. Joints: ASTM D 3212
   2. Gaskets: ASTM F 477 flexible elastomeric
   3. Fittings: same as pipe
2.2 INSTALLATION

A. Pipe shall be installed in accordance with the plans and above referenced specifications except as modified below.

B. Installation shall be in accordance with manufacturer's instructions.

2.3 EXISTING UTILITIES

A. Protect and maintain existing utilities.

2.4 RIGHT-OF-WAY

A. Working Right-of-Way: The Contractor shall confine his operations to the limits of the working right-of-way shown on the plans. He will be held responsible for any damage to adjacent property not within the limits of the right-of-way.

2.5 FIELD QUALITY CONTROL

A. Construction Observation and Testing.
   1. The Contractor will provide construction observation and testing through a qualified representative. The Contractor shall notify the Owner or the Owner's representative a minimum of 48 hours prior to any work.

2.6 CLEAN UP

A. Contractor shall do cleanup on areas as work progresses. Final payment shall not be made until the work areas are restored as required and all wastes and equipment removed. If final cleanup is not done within five (5) days of being requested to do so by the Owner's representative, the Owner may undertake such work and deduct costs from the Contractor retainage.

B. Excess Excavation: All excess excavated materials shall become the responsibility of the Contractor for disposal off the construction site. The Owner reserves the right to have selected excavated materials deposited at designated locations within the Project Limits at no additional cost to the Owner.

END OF SECTION