CONTRACT DOCUMENTS

AND

SPECIFICATIONS

FOR

CITY OF MIDDLETOWN

NEW COURTHOUSE FACILITY

CONTRACT NO. 1A – GENERAL CONSTRUCTION
CONTRACT NO. 1B – MECHANICAL CONSTRUCTION
CONTRACT NO. 1C – PLUMBING & FIRE PROTECTION CONSTRUCTION
CONTRACT NO. 1D - ELECTRICAL CONSTRUCTION

AUGUST 2024

PREPARED BY:

BARTON & LOGUIDICE, D.P.C.
443 ELECTRONICS PARKWAY
LIVERPOOL, NEW YORK 13088

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CITY OF MIDDLETOWN
NEW COURTHOUSE FACILITY

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SECTION 00 00 20

ADVERTISEMENT FOR BIDS

Sealed bids for the furnishing of all labor and material necessary for the City of Middletown New Courthouse Facility will be received by the City of Middletown Department of Public Works at 16 James Street, Middletown, New York 10940 until 3:30 P.M. local time on Tuesday, September 24, 2024, and then will be opened and read aloud publicly at 4:00 P.M.

Bids will be received for the following Contracts:

Contract No. 1A – General Construction: This work shall include providing all labor, materials, machinery, tools, equipment, and other means of construction necessary and incidental to the completion of the New Courthouse Facility. The project includes the work shown on the Plans, and described in these Specifications consisting of general construction. General construction includes, but is not limited to, the following: Selective demolition, installation of new metal stud gypsum wallboard partition walls, door, acoustical and sheet rocked ceilings/soffits, carpet and resilient tile flooring, plaster and paint finishes, wood platforms and millwork/paneling, ADA compliant bathrooms, signage and furniture to provide two new courtrooms, and support spaces. Work shall also include site work including site demolition, asphalt removal, new asphalt parking, concrete sidewalks, fencing, site landscaping and lawn areas, site lighting, and all other related items.

Contract No. 1B – Mechanical Construction: This work shall include providing all labor, materials, machinery, tools, equipment, and other means of construction necessary and incidental to the completion of the New Courthouse Facility. The project includes the work shown on the Plans, and described in these Specifications consisting of mechanical construction. Mechanical construction includes, but is not limited to, the following: Removal of existing rooftop units and boiler system (boiler, pumps, distribution piping, insulation, fin tube radiation), ductwork, ductwork insulation, exhaust fans, building management controls, air distribution devices, thermostats, and all other related demolition items; and new rooftop HVAC units, ductwork, insulation, boiler system, air distribution devices, building management controls system, exhaust fans, and all other related items.

Contract No. 1C – Plumbing and Fire Protection Construction: This work shall include providing all labor, materials, machinery, tools, equipment, and other means of construction necessary and incidental to the completion of the New Courthouse Facility. The project includes the work shown on the Plans, and described in these Specifications consisting of plumbing and fire protection construction. Plumbing and Fire Protection construction includes, but is not limited to, the following: Removal of existing plumbing fixtures, domestic water piping, sanitary and vent piping, and all other related demolition items; and new plumbing fixtures, domestic water piping, sanitary and vent piping, fire protection sprinkler system modifications, fire protection sprinkler system calculations, and all other related items.

Contract No. 1D – Electrical Construction: This work shall include providing all labor, materials, machinery, tools, equipment, and other means of construction necessary and incidental to the completion of the New Courthouse Facility. The project includes the work shown on the Plans, and described in these Specifications consisting of electrical construction. Electrical construction includes, but is not limited to, the following: Electrical demolition of existing interior spaces including lighting, outlets, miscellaneous circuits, and all other related demolition items; and installation of new interior and site lighting, outlets, circuiting, sound systems, fire alarm and security additions, data outlets, associated circuiting, and other related items.

Contract Documents, including Advertisement For Bids, Information For Bidders, Labor and Employment, Additional Instructions, Bid Documents, Agreement, General Conditions, General Requirements, Specifications, Contract Drawings and any Addenda, may be obtained from Barton & Loguidice, D.P.C., by providing contact information to jfelber@bartonandloguidice.com. Download instructions will be provided upon notification.

Each bid must be accompanied by security in an amount not less than five percentum (5%) of the amount of the bid in the form and subject to the conditions provided in the Information for Bidders. No Bidder may withdraw his bid within sixty (60) days after the actual date of opening thereof.

This is an exempt capital improvement project, and Bidders shall not include in their bid sales and compensating use taxes on the cost of materials which are to be incorporated into the work and which are to be separately sold by the Contractor to the City of Middletown prior to incorporation into the work of the Contracts.

A Pre-Bid Meeting will be held at the site (25 South Street, Middletown, NY) at 11:00 A.M. local time on Thursday, September 5, 2024. This meeting is optional but all prospective Bidders are urged to attend.

The attention of Bidders is particularly called to the requirements as to conditions of employment to be observed and minimum wage rates to be paid under the Contracts.

Project Contacts:
Zachary Comstock, R.A., P.L.A., E-mail: zcomstock@bartonandloguidice.com
Barton & Loguidice, D.P.C.
Tel: (315) 457-5200

The Board of Estimate and Apportionment reserves the right to reject any or all bids submitted, and to accept the bid which it considers to be in the best interest of the City of Middletown.

By Order of
THE BOARD OF ESTIMATE AND APPORTIONMENT
Jacob S. Tawil, P.E.
COMMISSIONER OF PUBLIC WORKS

END OF SECTION

SECTION 00 01 00

INFORMATION FOR BIDDERS

00 01 00.01 LOCATION OF THE WORK

A. The work under Contract Nos. 1A, 1B, 1C and 1D for City of Middletown New Courthouse Facility is located 25 South Street, Middletown, New York 10940.

00 01 00.02 DESCRIPTION OF THE WORK

A. The items of work include, but are not necessarily limited to the following:

Contract No. 1A – General Construction: This work shall include providing all labor, materials, machinery, tools, equipment, and other means of construction necessary and incidental to the completion of the New Courthouse Facility. The project includes the work shown on the Plans, and described in these Specifications consisting of general construction. General construction includes, but is not limited to, the following: Selective demolition, installation of new metal stud gypsum wallboard partition walls, door, acoustical and sheet rocked ceilings/soffits, carpet and resilient tile flooring, plaster and paint finishes, wood platforms and millwork/paneling, ADA compliant bathrooms, signage and furniture to provide two new courtrooms, and support spaces. Work shall also include site work including site demolition, asphalt removal, new asphalt parking, concrete sidewalks, fencing, site landscaping and lawn areas, site lighting, and all other related items.

Contract No. 1B – Mechanical Construction: This work shall include providing all labor, materials, machinery, tools, equipment, and other means of construction necessary and incidental to the completion of the New Courthouse Facility. The project includes the work shown on the Plans, and described in these Specifications consisting of mechanical construction. Mechanical construction includes, but is not limited to, the following: Removal of existing rooftop units and boiler system (boiler, pumps, distribution piping, insulation, fin tube radiation), ductwork, ductwork insulation, exhaust fans, building management controls, air distribution devices, thermostats, and all other related demolition items; and new rooftop HVAC units, ductwork, insulation, boiler system, air distribution devices, building management controls system, exhaust fans, and all other related items.

00 01 00.02 DESCRIPTION OF THE WORK - Continued

Contract No. 1C – Plumbing and Fire Protection Construction: This work shall include providing all labor, materials, machinery, tools, equipment, and other means of construction necessary and incidental to the completion of the New Courthouse Facility. The project includes the work shown on the Plans, and described in these Specifications consisting of plumbing and fire protection construction. Plumbing and Fire Protection construction includes, but is not limited to, the following: Removal of existing plumbing fixtures, domestic water piping, sanitary and vent piping, and all other related demolition items; and new plumbing fixtures, domestic water piping, sanitary and vent piping, fire protection sprinkler system modifications, fire protection sprinkler system calculations, and all other related items.

Contract No. 1D – Electrical Construction: This work shall include providing all labor, materials, machinery, tools, equipment, and other means of construction necessary and incidental to the completion of the New Courthouse Facility. The project includes the work shown on the Plans, and described in these Specifications consisting of electrical construction. Electrical construction includes, but is not limited to, the following: Electrical demolition of existing interior spaces including lighting, outlets, miscellaneous circuits, and all other related demolition items; and installation of new interior and site lighting, outlets, circuiting, sound systems, fire alarm and security additions, data outlets, associated circuiting, and other related items.

00 01 00.03 COMMENCEMENT AND COMPLETION OF THE WORK

A. Upon execution of the Contract including delivery of the Performance Bond, Labor & Materials Payment Bond and insurance policies and certificates by the Contractor to the Owner and the approval thereof by the Owner's attorney, the Contractor will be notified to proceed with the work. Such notification will be in the form of a letter to proceed from the Engineer.

B. The Contractor shall give the Engineer at least five (5) days written notice of the date he intends to start work at the site.

C. All work items of the Contracts shall be substantially completed within 365 calendar days following the date the Contractor is notified to proceed with the work unless such period is extended by the Owner as provided herein.

00 01 00.04 COLLATERAL WORK AND CONDITIONS OF WORK

A. Each Bidder shall inform himself fully of the conditions relating to the construction of the Project and the employment of labor thereon. Failure to do so will not relieve a successful Bidder, as Contractor, of his obligation to furnish all material and labor necessary to carry out the provisions of his Contract. Insofar as possible, the Contractor, in carrying out the work, shall employ such methods or means as will not cause any interruption of or interference with the work of any other Contractor. (See also Section 00 10 12.01.)

B. Each Contractor will be required to coordinate his work with the work of other Contracts. Each Contractor will be required to adjust his schedule accordingly.

00 01 00.05 RECEIPT & OPENING OF BIDS

A. The City of Middletown (herein called the Owner) invites Bids on the attached forms. Bids will be received by the Owner until the time and at the place stated in the attached Advertisement For Bids. Bids must be sealed in envelopes addressed to City of Middletown, Department of Public Works, 16 James Street, Middletown, New York 10940. The outside of the envelope shall bear the name and address of the Bidder and shall be labeled to clearly show the Contract designation for which the Bid is submitted.

00 01 00.06 INFORMALITIES, WAIVERS AND WITHDRAWALS

A. The Owner may consider informal any Bid not prepared and submitted in accordance with the provisions hereof and may waive any informalities in or reject any or all Bids. Bids which do not contain a price for every numbered item contained in the Bid form will not be accepted.

B. Any Bid may be withdrawn prior to the scheduled deadline for receipt of Bids or authorized postponement thereof, but no Bid may be withdrawn within sixty (60) days after the actual date of the opening thereof. Any Bid received after the time and date specified will not be considered, and will be returned unopened.

00 01 00.07 BID PREPARATION

A. Unless otherwise noted thereon, all blanks on the Bid forms must be appropriately filled in with ink and with both words and figures, and the Bid must be properly executed.

B. A separate digital file of the Bid forms is provided. Proposers shall print this file in its entirety. Proposers shall complete and submit the Bid forms with the required certifications, State of Surety's Intent and Bid Security. Successful Bidders shall have the Bid Forms inserted into the Contract Documents where appropriate at the time of Contract award.

00 01 00.08 ADDENDA AND INTERPRETATIONS

A. No verbal interpretation of the intent of any of the Contract Documents will be made before receipt of Bids. Requests for interpretations prior to receipt of Bids must be presented in writing to the Engineer, Barton & Loguidice, D.P.C., 443 Electronics Parkway, Liverpool, New York 13088, and to be given consideration must be received by the Engineer at least seven (7) days prior to the date set for the opening of Bids.

B. Any interpretation, and any additional information or instruction will, if issued, be in the form of a written Addendum or Addenda distributed to all holders of Contract Documents by the same method that the original documents were distributed, at least five (5) days prior to the date of the opening of Bids.

C. Failure of any Bidder to receive any such Addendum or interpretation shall not relieve such Bidder from any obligation under this Bid as submitted. All Addenda so issued shall become a part of the Contract Documents.

00 01 00.09 QUALIFICATIONS OF BIDDERS

A. The Owner reserves the right to make such investigation as he may deem necessary or advisable to determine any Bidder's ability to do the work, and the Bidder shall furnish to the Owner on request all data and information pertinent thereto. The Owner reserves the right to reject any Bid if such investigation fails to satisfy the Owner that the Bidder is fully qualified to do the work.

B. Conditional Bids will be considered informal and will be rejected.

C. Immediately following the Canvass of Bids the Low Bidder, if so requested, shall furnish the Owner a sworn and notarized financial statement, and a statement of his qualifications and experience.

00 01 00.10 OBLIGATIONS OF BIDDERS

A. At the time of the opening of Bids, each Bidder will be presumed to have inspected the Site, to have informed himself fully of the conditions relating to the work and labor required for the work, and to have read and acquainted himself with all the Contract Documents. Failure to do so will not relieve the Bidder who is awarded the Contract of his obligation to complete the work for the price or prices bid, or of any other obligation under the Contract. The failure or omission of any Bidder to receive or examine any Contract Documents shall in no way relieve him from any obligation in respect to his Bid.

00 01 00.11 BID SECURITY

A. Each Bid must be accompanied by cash in United States currency or a certified check of the Bidder in an amount not less than five percent (5%) of the Bid. A Bid Bond, fully executed by the Bidder as principal, and having as surety thereon a surety company approved by the Owner and authorized to do business in New York State, will be accepted in lieu of cash or certified check. Checks should be made payable to the Owner.

B. Such cash, checks or Bid Bonds will be returned to all except the three lowest Bidders within three working days after the opening of Bids. The remaining deposits will be returned to the three lowest Bidders within three working days after execution of the Contract, or, if no Contract is executed within 60 calendar days after opening of Bids, upon demand of the Bidder at any time thereafter so long as he has not been notified of the acceptance of his Bid.

00 01 00.12 LIQUIDATED DAMAGES FOR FAILURE TO EXECUTE CONTRACT

A. Should the successful Bidder refuse or fail to execute the Contract and Bond within five (5) working days after receipt of notice of the acceptance of his Bid, the security deposited with his Bid shall be forfeited to the Owner as liquidated damages for such refusal or failure.

00 01 00.13 DISCREPANCY IN BIDS

A. In the event a discrepancy exists in any Bid between the prices written in words and the prices written in figures, the prices written in words shall govern. If a discrepancy exists in any Bid between unit prices and the extended totals therefor, the unit prices shall govern. In either of the above cases, the extended totals, and the total of all extensions, shall be corrected, if necessary, and the Bid may not be considered informal.

00 01 00.14 LOWEST BIDDER

A. Bids will be compared on the basis of the totals for the Contract, corrected as necessary in conformance with Article 00 01 00.13, given at the bottom of the schedule of quantities, prices and extensions. Such total in each Bid shall be the sum of all lump sum prices, plus the sum of all the extensions produced by multiplying the unit price in each case by the corresponding listed quantity.

00 01 00.15 AWARD OF CONTRACT

A. The Contract will be awarded to that responsible Bidder whose Bid, after corrections and adjustments, totals the least number of dollars.

B. The Owner reserves the right to reject any and all Bids.

END OF SECTION

SECTION 00 01 50

LABOR AND EMPLOYMENT

00 01 50.01 GENERAL

A. The Contractor and every Subcontractor on public works contracts shall comply with Article 8 of the State Labor Law, as amended.

00 01 50.02 POSTING MINIMUM WAGE RATES & KEEPING RECORDS

A. The Contractor and every Subcontractor on public works contracts shall post in a prominent and accessible place on the Site a legible statement of all wage rates and supplements as specified in the Contract to be paid or provided, all redeterminations of such schedules as the case may be, for the various classes of mechanics, workmen and laborers employed on the work. Other notices to be posted are the Workers' Compensation Law Section 51 notice, the Department of Labor notice that this project is a public work project on which each worker is entitled to receive the prevailing rate of wages and supplements for the occupation at which he or she is working, and all other notices required by law to be posted at the site. The Contractor shall maintain such notices in a legible manner, written in plain English in lettering no smaller than two inches in height and two inches in width, weatherproof, and shall replace any notice or schedule which is damaged, defaced, illegible or removed for any reason.

B. The Contractor and every Subcontractor shall keep original payrolls or verified transcripts thereof showing the hours and days worked by each workman, mechanic or laborer, the occupation at which he worked, the hourly wage rate paid and the supplements paid or provided, on the Site, when the Contractor or Subcontractor maintains no regular place of business in New York State and where the amount of the Contract is in excess of $25,000. All other Contractors and Subcontractors shall produce within five days on the Site and upon formal order of the Commissioner of Labor or his designated representative such original payrolls or verified transcripts thereof, as may be deemed necessary to adequately enforce the provisions of this Section.

C. Notwithstanding the aforementioned requirements, every Contractor and Subcontractor shall submit to the Owner within thirty days after issuance of its first payroll, and every thirty days thereafter, a transcript of the original payroll record, as provided by Article 8 of the Labor Law, subscribed and affirmed as true under penalties of perjury. The original payrolls or transcripts shall be preserved for three years from the completion of the work.

00 01 50.03 NON-DISCRIMINATION AND LABOR PRACTICES

A. In accordance with Section 220-e of Article 8 of the State Labor Law, the Contractor agrees:

1. That in the hiring of employees for the work of this Contract or any Subcontract, neither he nor any Subcontractor, nor any person acting on behalf of the Contractor, or any Subcontractor, shall by reasons of race, creed, color, sex or national origin discriminate against any citizen of the State of New York who is qualified and available to perform the work to which his employment relates; and

2. That neither the Contractor, nor any Subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee hired for the performance of work under this Contract on account of race, creed, color, sex, disability or national origin; and

3. That there may be deducted from the amount payable to the Contractor by the Owner, a penalty of Fifty Dollars for each person for each calendar day during which such person was discriminated against or intimidated in violation of the provisions of this Contract; and

4. That this Contract may be cancelled or terminated by the Owner, and all monies due or to become due hereunder may be forfeited, for a second or any subsequent violation of the terms or conditions of this Section of the Contract; and

5. That the aforesaid provisions of this Section covering contracts for the manufacture, sale or distribution of materials, equipment or supplies shall be limited to operations performed within the territorial limits of the State of New York.

6. During the performance of this Contract, the Contractor agrees as follows:

   a. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, disability or national origin, and will take affirmative action to insure that they are afforded equal employment opportunities without discrimination because of race, creed, sex, color or national origin. Such action shall be taken with reference, but not be limited to: recruitment, employment, job assignment, promotion, upgrading, demotion, transfer, layoff or termination, rates of pay or other forms of compensation, and selection for training or retraining, including apprenticeship and on-the-job training.

b. The Contractor will send to each labor union or representative of workers with which he has or is bound by a collective bargaining or other agreement or understanding, a notice to be provided by the State Division of Human Rights, advising such labor union or representative of the Contractor's agreement under subparagraphs (1) through (7) (hereinafter called "non-discrimination clauses"). If the Contractor was directed to do so by the contracting agency as part of the Bid or negotiation of this Contract, the Contractor shall request such labor union or representative to furnish him with a written statement that such labor union or representative either will affirmatively cooperate, within the limits of its legal and contractual authority, in the implementation of the policy and provisions of these non-discrimination clauses or that it consents and agrees that recruitment, employment and the terms and conditions of employment under this Contract shall be in accordance with the purposes and provisions of these non-discrimination clauses. If such labor union or representative fails or refuses to comply with such a request that it furnish such a statement, the Contractor shall promptly notify the State Division of Human Rights of such failure or refusal.

c. The Contractor will post and keep posted in conspicuous places, available to employees and applicants for employment, notices to be provided by the State Division of Human Rights setting forth the substance of the provisions of subparagraphs (1) and (2) and such provisions of the State's laws against discrimination as the State Commissioner of Human Rights shall determine.

d. The Contractor will state, in all solicitations, or advertisements for employees placed by or on behalf of the Contractor, that all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, sex, color, disability or national origin.

e. The Contractor will comply with the provisions of Sections 291-299 of the Executive Law and the Civil Rights Law, will furnish all information and reports deemed necessary by the State Commissioner of Human Rights under these non-discrimination clauses and such sections of the Executive Law, and will permit access to his books, records and accounts by the State Commissioner of Human Rights, the Attorney General and the Commissioner of Labor for purposes of investigation to ascertain compliance with these non-discrimination clauses and such sections of the Executive Law and Civil Rights Law.

f. This Contract may be forthwith cancelled, terminated or suspended, in whole or in part, by the contracting agency upon the basis of a finding made by the State Commissioner of Human Rights that the Contractor has not complied with these non-discrimination clauses, and the Contractor may be declared ineligible for future contracts made by or on behalf of the State or a public authority or agency of the State, until he satisfies the State Commissioner of Human Rights that he has established and is carrying out a program in conformity with the provisions of these non-discrimination clauses. Such finding shall be made by the State Commissioner of Human Rights after conciliation efforts by the State Division of Human Rights have failed to achieve compliance with these non-discrimination clauses and after verified complaint has been filed with the State Division of Human Rights, notice thereof has been given to the Contractor and an opportunity has been afforded him to be heard publicly before the State Commissioner of Human Rights or his designee. Such sanctions may be imposed and remedies otherwise provided by law.

g. The Contractor will include the provisions of sub-paragraph (1) through (7) of this paragraph A and in every Subcontract or purchase order in such a manner that such provisions will be binding upon each Subcontractor or vendor as to operations to be performed within the State of New York. The Contractor will take such action in enforcing such provisions of such Subcontract or purchase order as the contracting agency may direct, including sanctions or remedies for non-compliance. If the Contractor becomes involved in or is threatened with litigation with a Subcontractor or vendor as a result of such direction by the contracting agency, the Contractor shall promptly so notify the Attorney General, requesting him to intervene and protect the interest of the State of New York.

7. It is hereby agreed that all applicable provisions of the Labor Law of the State of New York shall be carried out in the performance of this Contract.

8. This agreement shall be void and of no effect unless the Contractor shall secure compensation insurance for the benefit of, and keep insured during the life of this agreement, such employees engaged therein as are required to be insured by the provisions of the Worker's Compensation Law of the State of New York.

00 01 50.04 LEGAL DAY'S WORK

A. In accordance with Section 220 (2) of Article 8 of the State Labor Law, no laborer, workman or mechanic employed by the Contractor, a Subcontractor or other person doing or contracting to do any part of the work shall be permitted or required to work more than eight hours in any one calendar day or more than five days in any week except in cases of extraordinary emergency including fire, flood or danger to life or property, or in case of national emergency when so proclaimed by the President of the United States.

00 01 50.05 WAGE RATES

A. In accordance with Section 220 of Article 8 of the State Labor Law, the wages to be paid for a legal day's work, as hereinbefore defined, to laborers, workmen or mechanics employed by the Contractor or Subcontractors, shall be not less than the prevailing rate of wages as hereinafter defined. Each laborer, workman or mechanic employed by the Contractor, Subcontractors, or other person upon or about the work, shall be paid not less than the wages and supplements herein provided.

B. Any person or corporation that willfully pays or provides less than the stipulated wage scale or supplements shall be guilty of a misdemeanor and upon conviction shall be punished as provided by law.

C. It shall be the duty of the Commissioner of Labor, or, if the Owner is a city, the comptroller or other analogous officer of such city, to make a determination of the schedule of wages to be paid all laborers, workmen and mechanics employed on the project (if it is a public works project) including supplements for welfare, pension, vacation and other benefits. These supplements include hospital, surgical or medical insurance or benefits, life insurance or death benefits, accidental death or dismemberment insurance, and pension or retirement benefits. If the amount of supplements provided by the employer is less than the total supplements shown on the wage schedule, the difference shall be paid in cash to employees.

D. The supplements to be provided shall be in accordance with prevailing practices in the locality. The amount for wages and for supplements listed in the schedule in these Contract Documents does not necessarily include all types of prevailing wages and supplements in the locality, and a future determination by the Commissioner of Labor may require the Contractor to pay increased wages or provide additional supplements.

00 01 50.06 VERIFICATION OF AMOUNTS DUE FOR WAGES AND SUPPLEMENTS

A. In accordance with Section 220-a of Article 8 of the State Labor Law, the New York State schedule of prevailing wages and supplements, as included in this Contract or as subsequently redetermined by the New York State Department of Labor, shall be specifically included in each and every Subcontract, regardless of tier, awarded by the Contractor or his Subcontractors.

B. Subcontractors, regardless of tier, shall provide to the Contractor a verified statement attesting that the Subcontractor has received and reviewed the prevailing wage rate and supplement schedule and agreeing that it will pay its employees the applicable wages and will pay or provide the supplements specified therein. The Contractor shall submit to the Owner copies of all such verified statements.

C. The Owner will not make final payment to the Contractor unless and until the Contractor submits the following:

1. verified statements as described in the preceding paragraph
2. certification to the amounts then due from the Contractor to any and all laborers for wages or supplements on account of labor performed upon the work under the Contract
3. certification to the amounts then due from any Subcontractor, regardless of tier, for wages and supplements, on account of labor performed upon the work under the Contract, or shall certify that the Contractor has no knowledge of such amounts owing to or on behalf of any laborers of its Subcontractors.

D. In the event it is determined by the New York State Commissioner of Labor that the wages and/or supplements of any employees of the Contractor's Subcontractors, regardless of tier, have not been paid or provided pursuant to the appropriate schedule of wages and supplements, the Contractor shall be responsible for payment of such wages or supplements.

00 01 50.07 MINIMUM RATES

A. New York State Department of Labor wage rates will be in effect on this Project.

B. The minimum wage rates designated by the Commissioner of Labor of the State of New York are attached. These minimum rates and supplements may be modified during the life of the Contract. If the prevailing wage rates should subsequently be legally modified or increased by any means other than by the action of the Owner, the Contractor shall assume full responsibility for the payment of said increases without recourse to the Owner.

END OF SECTION

STATE PREVAILING WAGE RATES

The Contractor shall ensure that workers are paid the appropriate wages and supplemental (fringe) benefits. Throughout the Contract, the Contractor shall obtain and pay workers in accordance with periodic wage rate schedule updates from the NYS Department of Labor (NYSDOL). Wage rate amendments and supplements are available on the NYSDOL web site at **www.labor.state.ny.us.** All changes or clarification of labor classification(s) and applicability of prevailing wage rates shall be obtained in writing from the Office of the Director, NYSDOL Bureau of Public Work.

The NYSDOL prevailing wage rate schedule for this Contract has been determined and is available on the internet. The prevailing wage rate schedule is accessed by visiting the NYSDOL web site, navigating to the appropriate web page, and entering the Prevailing Rate Case Number **PRC# 2022013579** for Contract No. 1A – General Construction, Contract No. 1B – Mechanical Construction, Contract No. 1C – Plumbing Construction, and Contract No. 1D – Electrical Construction.

A copy of the project specific prevailing wage rate schedule will be provided to the successful Bidder upon award of the Contract. Upon written request, the schedule will be provided to prospective Bidders without internet access.

SECTION 00 01 60

ADDITIONAL INSTRUCTIONS

00 01 60.01 BORINGS AND SUBSURFACE DATA

A. No soil borings were taken at the site of the project.

00 01 60.02 PRECONSTRUCTION CONFERENCE

A. A preconstruction conference will be held after award of the Contract, but prior to commencement of construction, at the office of the Engineer, and the Contractor shall have an authorized representative of his firm present at this meeting.

00 01 60.03 POWER OF ATTORNEY

A. Attorneys-in-fact who sign Bid Bonds or Contract Bonds must file with each bond a certified and effectively dated copy of their power of attorney.

00 01 60.04 LAWS AND REGULATIONS

A. The Bidder's attention is directed to the fact that all applicable Federal and State laws, municipal ordinances and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the Contract throughout, and they will be deemed to be included in the Contract the same as though herein written out in full.

00 01 60.05 NON-COLLUSIVE BIDDING CERTIFICATION

A. A Non-Collusive Bidding Certification form as bound in these Documents must be executed and accompany the Bid.

00 01 60.06 IRANIAN ENERGY SECTOR DIVESTMENT CERTIFICATION

A. The Bidder hereby represents that said Bidder is in compliance with New York State General Municipal Law Section 103-g entitled “Iranian Energy Sector Divestment”.

B. By submission of this Bid, each Bidder and each person signing on behalf of any Bidder certifies and in the case of a joint Bid, each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief, that each Bidder is not on the list created pursuant to NYS Finance Law Section 165-a(3)(b).

C. The Bidder shall submit a signed, notarized and dated Iranian Energy Sector Divestment Certification with its Bid.

D. Said certification is mandated by Section 103-g of the General Municipal Law. Reference the Iranian Energy Sector Divestment Certification form included in Section 00 03 73 of this Bid Document.

00 01 60.07 PREVENTION OF SEXUAL HARASSMENT COMPLIANCE

A. The Bidder hereby represents that said Bidder is in compliance with New York State General Municipal Law Section 201-g entitled “Prevention of Sexual Harassment”.

B. By submission of this Bid, each Bidder and each person signing on behalf of any Bidder certifies, and in the case of a joint Bid each party thereto certifies as to its own organization, under penalty of perjury, that the Bidder has and has implemented a written policy addressing sexual harassment prevention in the workplace and provides annual sexual harassment prevention training to all of its employees. Such policy shall, at a minimum, meet the requirements of Section 201-g of the Labor Law.

C. The Bidder shall submit a signed, notarized, and dated Bidder’s Statement on Sexual Harassment Certification provided in Section 00 03 76, “Bidder’s Statement on Sexual Harassment”.

00 01 06.08 CHANGES AND AMPLIFICATIONS TO GENERAL CONDITIONS

00 07 53.01 REPRESENTATIONS OF CONTRACTOR

In Paragraph B, ADD "Further, he has notified Engineer in writing of and discrepancies, errors or omissions in the Contract Documents or Specifications."

00 07 61.02 INTERPRETATION OF PLANS AND SPECIFICATIONS

In amendment to this Article, Bidders are advised of their responsibility to immediately notify the Engineer in writing, as the Owner's representative, of any errors, emissions, discrepancies or inconsistencies which the Bidder may determine through review of the Plans and Specifications during the bidding period. Final interpretation of such items shall be by the Engineer and shall be rectified, if required, by addendum, in accordance with Article 00 01 00.08. Bidders are also advised that the successful Bidder, as Contractor, shall in no way take advantage of, nor shall be entitled to additional compensation for any prior knowledge of such errors, omissions, discrepancies or inconsistencies not disclosed to the Engineer during the bidding period.

00 01 60.09 CHANGES AND AMPLIFICATIONS TO GENERAL REQUIREMENTS

00 13 40.02 TRANSMITTAL, IDENTIFICATION AND RESUBMITTAL

Contractor may provide drawings and other data to Engineer and Owner via electronic means as reasonably acceptable to Engineer and Owner. Contractor shall maintain logs of submittals, indicating the action item owner, due dates, timing, and brief description. More than TWO resubmittals shall be considered an additional cost to the Engineer, paid for by the Contractor.

00 13 40.06 DRAWINGS TO BE CHECKED BY THE CONTRACTOR

The Contractor is responsible to verify all dimensions, quantities and representations in the Contract Documents. Should the Contractor identify any discrepancies, the Owner and Engineer shall be notified immediately.

00 15 80 PROJECT SIGNS

Delete in its entirety.

00 15 90 ENGINEER'S FIELD OFFICE TRAILER

Delete in its entirety.

00 01 60.10 ADDITIVE BID ITEMS

Contract No. 1A – General Construction:

Additive Bid Item No. 1 – Roof Replacement: Remove and Replace the main roof level, elevator penthouse, and lower entry roofs, and furnish and install new roof curbs on rooftop mechanical equipment as shown and detailed on Contract Documents.

Additive Bid Item No. 2 – Front Entrance Canopy: Furnish and install new front entrance canopy and associated site work on the south side of the building as shown and detailed on Contract Documents.

Additive Bid Item No. 3 – Rear Canopy: Furnish and install new rear canopy on the west and north sides of the building as shown and detailed on Contract Documents.

Contract No. 1B – Mechanical Construction:

Additive Bid Item No. 1 – Roof Replacement: Remove and Replace the main roof level, elevator penthouse, and lower entry roofs, and furnish and install new roof curbs on rooftop mechanical equipment as shown and detailed on Contract Documents.

00 01 60. 11 CITY OF MIDDLETOWN CONTACT

A. Contractors who are unable to attend the Pre-Bid Meeting may contact the Coty of Middletown PDW Office at 845-343-3169 to request access to the project site. Any interpretations or inquires must be submitted in writing to the Engineer, refer to 00 01 00.08 - ADDENDA AND INTERPRETATIONS for additional information.

00 01 60.12 CITY OF MIDDLETOWN LICENSING REQUIREMENTS

A. Plumbing Contractors must be licensed by the City of Middletown per the Code of the City of Middletown, Chapter 356 Plumbers and Plumbing Standards.

B. Electrical Contractors must be licensed by the City of Middletown per the Code of the City of Middletown, Chapter 235 Electricians and Electrical Standards.

END OF SECTION

The following sections are a separate digital file.

DIVISION 00 [03 & 04]

BIDDING & CONTRACT REQUIREMENTS

SECTION 00 05 70

AGREEMENT

This CONTRACT, in six (6) copies, made and entered into this _____ day of _____, 20___, by and between the City of Middletown, a municipal corporation, organized and existing under the laws of the State of New York, with its principal office and place of business located at 16 James Street, Middletown, New York 10940, hereinafter designated as "Owner", Party of the First Part,

and _____

_____

_____ of _____

County of _____ State of _____

hereinafter designated as the Contractor, Party of the Second Part.

WITNESSETH: That the parties hereto, each in consideration of the Agreements on the part of the other herein contained, have mutually agreed, and hereby mutually agree, the Party of the First Part for itself and its successors, and the Party of the Second Part for itself, himself or themselves and its successors, his or their executors, administrators and assigns as follows:

Article 1. DESCRIPTION. Under this Agreement and Contract, the Contractor shall furnish all materials and perform all work required to furnish and install complete Contract No. _____.

Article 2. In consideration of the payments to be made as hereinafter provided, and of the performance by the Owner of all matters and things to be performed by the Owner as hereinafter provided, the Contractor agrees, at his own sole cost and expense to perform all the labor and services, and to furnish all the labor and materials, plant and equipment necessary to complete, and to complete in good, substantial, workmanlike and approved manner, the work described under Article 1 hereof, within the time hereinafter specified and in accordance with the terms, conditions and provisions of this Contract and with the instructions, order and directions of the Engineer made in accordance with this Contract.

Article 3. The Owner agrees to pay and the Contractor agrees to accept, as full compensation for all work done and materials furnished, and also for all costs and expense incurred, and loss or damages sustained by reason of the action of the elements or growing out of the nature of the work, or from any unforeseen obstruction or difficulty encountered in the prosecution of the work, and for all risks of every description connected with the work, and for all expenses incurred by, or in consequence of, the suspension or discontinuance of the work as herein specified, and for well and faithfully completing the work, and the whole thereof, as herein provided, and for maintaining the work in good condition until the final payment is made, the prices stipulated in the proposal hereto attached.

Article 4. CONTRACT DOCUMENTS. The following Documents shall constitute integral parts of the Agreement, the whole to be collectively known and referred to as the Contract: Advertisement For Bids, Information for Bidders, Wage Rates, Additional Instructions, Bid Documents, Agreement, Performance Bond, Labor & Materials Payment Bond, Insurance Certificates, General Conditions, General Requirements, Specifications, Contract Drawings, and all interpretations of, or addenda to the CONTRACT DOCUMENTS issued by the Owner or the Engineer with the approval of the Owner.

The Table of Contents, Indices, Headings, Titles contained herein and in said documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light on the interpretations of the provisions to which they refer.

Article 5. Contractor agrees to comply with all requirements of the Contract Documents and with all provisions of law and implementing regulations. If the Contractor shall fail to comply with any of the terms, conditions, provisions, or stipulations of this Contract, then the Owner may make use of any or all remedies at law or in equity, or as provided in the Contract and shall have the right and power to proceed in accordance with the provisions thereof.

Article 6. The following alterations and addenda have been made and included in this Contract before it was signed by the parties hereto:

_____

_____

_____

Article 7. This agreement shall be construed and enforced in accordance with the laws of the State of New York.

Article 8. The Contractor agrees:

(a) He hereby voluntarily and irrevocably submits himself to the jurisdiction and venue of any court of competent jurisdiction over the subject matter of this Contract located within the State of New York in which any litigation is brought based on or arising out of this Contract.

(b) Any litigation brought by the Contractor based on or arising out of this Contract shall be brought only in the Supreme Court of the State of New York within the County in which the Owner is located.

(c) Any legal process or notice connected with any litigation may be served on the Contractor by United States registered mail, postage pre-paid, addressed to the Contractor at his address stated in this Contract or at the Address stated in this Contract for the furnishing of notices to the Contractor or at the Contractor's last known address, and that service in such manner shall constitute good and valid service of process upon the Contractor.

(d) The Contractor hereby waives any defense which might be available to it in any such litigation based on or alleging lack of jurisdiction or venue, or, if process is served in the manner provided in Subparagraph (c) immediately above, invalid service of process, and that he will duly enter his appearance in any such action.

(e) This Contract may be presented in court as conclusive evidence of the foregoing agreement.

IN WITNESS WHEREOF, the parties to this Agreement have hereunto set their hands and seals and have executed this Agreement in six (6) copies the day and year first above written.

_____ (OWNER)

By: _____

(Seal)

CONTRACTOR

_____

(Seal) By: _____

(ACKNOWLEDGMENT OF OFFICER OF OWNER ATTESTING CONTRACT)

State of _____)
) SS:
County of _____)

On this _____ day of _____, 20____, before me personally came and appeared _____to me known, who, being by me duly sworn, did depose and say that he is the _____ of the _____described in and which executed the foregoing instrument; that he knows the seal of said Owner; that one of the impressions appearing on said instrument is a true and correct impression of such seal; and that he affixed it thereto and attested the same over his signature by virtue of the authority in him vested.

_____

(ACKNOWLEDGMENT OF CONTRACTOR, IF A CORPORATION)

State of _____)
) SS:
County of _____)

On this _____ day of _____, 20____, before me personally came and appeared _____to me known, who, being by me duly sworn, did depose and say that he resides at _____ _____; that he is the _____ of _____, the corporation described in and which executed the foregoing instrument; that he knows the seal of said corporation; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the directors of said corporation, and that he signed his name thereto by like order.

_____

(ACKNOWLEDGMENT OF CONTRACTOR, IF A PARTNERSHIP)

State of _____)
) SS:
County of _____)

On this _____ day of _____, 20____, before me personally came and appeared _____to me known and known to me to be one of the members of the firm of _____ described in and who executed the foregoing instrument, and he acknowledged to me that he executed the same as and for the act and deed of said firm.

_____

(ACKNOWLEDGMENT OF CONTRACTOR, IF AN INDIVIDUAL)

State of _____)
) SS:
County of _____)

On this _____ day of _____, 20____, before me personally came and appeared_____ to me known and known to me to be the person described in and who executed the foregoing instrument and acknowledged that he executed the same.

_____

(ACKNOWLEDGMENT OF CONTRACTOR, IF A LIMITED LIABILITY COMPANY)

State of _____)
) SS:
County of _____)

On this _____ day of _____, 20____, before me personally came and appeared _____, to me known, who being by me duly sworn, did depose and say that he resides at _____ _____; that he is the _____ of _____, the limited liability company described in and which executed the foregoing instrument; that he knows the seal of said limited liability company; that one of the seals affixed to said instrument is such seal; that it was so affixed by order of the managing members of said limited liability company, and that he signed his name thereto by like order.

_____

(Certification of Owner's Attorney)

I, the undersigned, the duly authorized and acting legal representative of _____ _____ do hereby certify as follows:

I have examined the foregoing Contract and surety bonds and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with the terms, conditions and provisions thereof.

By:_____
Owner's Attorney

_____
(Date)

END OF SECTION

SECTION 00 06 10

PERFORMANCE BOND

(ATTACH PERFORMANCE BOND HERE)

END OF SECTION

SECTION 00 06 20

LABOR & MATERIALS PAYMENT BOND

(ATTACH LABOR & MATERIALS PAYMENT BOND HERE)

SECTION 00 06 50

CERTIFICATE OF INSURANCE

(ATTACH INSURANCE CERTIFICATES HERE)

GENERAL CONDITIONS

SECTION 00 07 50

DEFINITIONS OF WORDS & TERMINOLOGY

00 07 50.01 DEFINITIONS OF WORDS AND TERMS

Wherever the following words or corresponding pronouns are used in this Contract, they shall have the meaning given herein:

A. CONTRACT, OR CONTRACT DOCUMENTS: each of the various documents referred to in the Agreement, both severally and as a whole, including all additions, deletions, modifications and interpretations incorporated therein or appended thereto by or with approval of the Owner prior to the execution of the Contract.

B. OWNER: the party of the first part to this Contract, or any duly authorized agents or officers empowered to act therefor.

C. CONTRACTOR: the party of the second part to this Contract, or the legal representatives or agents appointed by said party for the performance of the work.

D. ENGINEER: the firm of Barton & Loguidice, engaged by the Owner to provide Engineering services in connection with the work of this Contract, or its representatives duly authorized in writing to act therefor.

E. SURETY: the person, persons, firm or corporation who executes the Contractor's Performance Bond and Labor & Materials Payment Bond.

F. SUBCONTRACTOR: any person, other than employee of the Contractor, or any firm or corporation who contracts to act for or in behalf of the Contractor in performing any part of the work in connection with the Contract, exclusive of one who furnishes only materials or equipment.

G. PROJECT: the entire facility or improvement to which the Contract relates.

H. SITE: the area or areas bounded by the property lines shown on the Plans, and other areas that may be similarly designated.

I. THE WORK: all labor, equipment and materials required, either expressly or by implication, to be furnished by the Contractor under this Contract or in connection with Change Orders or Supplemental Agreements thereto.

J. SUPPLEMENTAL AGREEMENT: an alteration or modification of the Contract Documents, made after execution of the Contract and agreed to in writing by the Contractor and the Owner.

K. CHANGE ORDER: a written order from the Owner to the Contractor directing an alteration or modification of the nature, scope or type of the work.

L. BOND OR PERFORMANCE BOND: the guarantee signed by the Surety, that the Contractor will complete all the work as required by the Contract.

M. LABOR & MATERIALS PAYMENT BOND: the guarantee, signed by the Surety, that the Contractor will pay for all Labor and Material required by the Contract.

N. SPECIFICATIONS: also referred to as DETAIL SPECIFICATIONS or TECHNICAL SPECIFICATIONS. The written directions, requirements, descriptions of materials, equipment, construction systems, standards and workmanship as applied to the work and specifically including Division 2 - Division 48 of the Contract Documents.

O. PLANS, DRAWINGS OR CONTRACT DRAWINGS: only those drawings listed as such in the Contract Documents with all Addenda thereto.

P. SHOP DRAWINGS, SETTING DRAWINGS, WORKING DRAWINGS, CONSTRUCTION DRAWINGS: drawings prepared, or caused to be prepared, by the Contractor, Subcontractors, or by their equipment or material suppliers in their behalf, including standard or stock equipment drawings, necessary to the performance of the work in addition to the Contract Drawings, or as may be required by the Engineer to be submitted for review.

Q. ADDITIONAL DRAWINGS, SUPPLEMENTARY DRAWINGS: drawings, in addition to the Contract Drawings, which may be prepared and issued by the Engineer as part of the instructions to or requests of the Contractor in connection with the work of the Contract or appertaining to changes in the work.

R. ADDENDUM, ADDENDA: additional Contract provisions, deletions or changes issued by the Owner prior to the receipt of bids.

S. WRITTEN NOTICE: all written and authoritatively signed communications required in the normal conduct of the work or required to obtain compliance with the Contract provisions or preserve the rights of any party to the Contract. Written notice shall be considered as served when either delivered in person or deposited in a post-paid wrapper in a regularly maintained U.S. Mailbox and addressed to the person, firm or corporation intended to receive such notice, or to their appropriate agent, to the last business address of such known to the server. If mailed, the period of notice shall run from the time of the postal cancellation. It shall be incumbent upon each party to the Contract, and the Engineer, to advise the other parties to the Contract, and the Engineer, of any change in their business address until completion of the Contract and the expiration of all guarantee periods connected therewith.

T. DIRECTED, ORDERED, REQUIRED, DESIGNATED, PERMITTED, GRANTED, INSTRUCTED, CONSIDERED NECESSARY, APPROVED, SATISFACTORY, ACCEPTABLE: words referring to action or satisfaction of the Engineer, unless another meaning is specifically stated. The same shall apply to words of like import.

U. AS SHOWN, AS SHOWN ON THE PLANS: words referring to lines, numbers, or statements, or combinations thereof, on the Contract Drawings, unless another meaning is specifically stated.

V. ELEVATION: or any abbreviation of the word "elevation", followed by figures, shall refer to the distance in feet above the datum established by the Engineer for the Project.

W. ACT OF GOD: an earthquake, flood, excessive wind or other unusual natural occurrence. Rain, snow, wind, flood, lightning or other natural phenomenon of normal intensity for the locality shall not be included in the meaning of the term.

X. APPROVED EQUAL, EQUAL: in the Contract Documents or Contract Drawings wherever brand names are specified and followed by the phrase "or approved equal", this phrase shall be modified to read "or equal".

00 07 50.02 REFERENCES TO OTHER SPECIFICATIONS AND CODES

References in these Specifications to published specifications and codes of private and governmental technical societies and agencies shall mean the latest specification for the item or operation involved. Abbreviations of these organizations used in these Specifications may include the following:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AGA	American Gas Association
AGCA	Associated General Contractors of America
AGMA	American Gear Manufacturers Association
AISC	American Institute of Steel Construction
AMCA	American Mechanical Contractors Association
ANSI	American National Standards Institute
APWA	American Public Works Association
ARI	American Refrigeration Institute
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration & Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWS	American Welding Society

AWWA	American Water Works Association
CEMA	Conveyor Equipment Manufacturers Association
CIPRA	Cast-Iron Pipe Research Association
FM	Factory Mutual System
HEI	Heat Exchange Institute
HI	Hydraulics Institute
IEEE	Institute of Electrical and Electronics Engineer
IPCEA	Insulated Powers Cable Electric Association
NAFM	National Association of Fan Manufacturers
NBC	National Building Code
NBFPU	National Board of Fire Protection Underwriters
NBCA	National Bituminous Concrete Association
NCPI	National Clay Pipe Institute
NEC	National Electrical Code
NELA	National Electrical Lamp Association
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NSWMA	National Solid Wastes Management Association
NYSDOT	New York State Department of Transportation, Standard Specifications (Construction and Materials)
NYSECC	New York State Energy Conservation Code
OSHA	Occupational, Safety and Health Act
PCA	Portland Cement Association
SAE	Society of Automotive Engineers
SMACNA	Sheet Metal & Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
UL	Underwriter Laboratories', Inc.
USEPA	United States Environmental Protection Agency

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 51

POWERS AND DUTIES OF ENGINEER

00 07 51.01 RESPONSIBILITY OF THE ENGINEER

A. The Engineer shall decide questions which may arise as to the quality and acceptability of materials furnished, work performed, rate of progress of work, interpretation of Drawings and Specifications and all questions as to the acceptable fulfillment of the Agreement on the part of the Contractor. The duties and responsibilities of the Engineer as set forth herein shall not be extended except through written consent of the Engineer and the Owner.

1. Observation of the Work: The Engineer will make periodic visits to the site to observe the progress and the quality of the executed work. All materials and each part or detail of the work shall be subject at all times to observation by the Engineer and the Owner, and the Contractor will be held strictly to the intent of the Contract Documents in regard to quality of materials, workmanship, and the diligent execution of the Contract. Observations may be made at the site or at the source of material supply, whether mill, plant or shop. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make their observations and construction review.

2. Acceptability of Work: The Engineer's decision as to the acceptability or adequacy of the work shall be final and binding upon the Contractor. The Contractor agrees to abide by the Engineer's decision relative to the acceptability of the work.

3. Engineer's Decisions: All claims of the Owner or the Contractor shall be presented to the Engineer for decision which shall be final except in cases where time and/or financial considerations are involved.

4. The Engineer shall not be responsible for the Contractors or any Subcontractor's construction means, methods, controls, techniques, sequences, procedures or construction safety or their failure to complete the work in accordance with the Contract Documents.

5. Oral Agreements: No oral order, objection, claim or notice by any party to the others shall affect or modify any of the terms or obligations contained in any of the Contract Documents, and none of the provisions of the Contract Documents shall be held to be waived or modified by reason of any act whatsoever, other than by a definitely agreed waiver or

modification thereof in writing, and no evidence shall be introduced in any proceedings of any other waiver or modification.

00 07 51.02 INSPECTION OF WORK

A. Inspection services, performed by the Engineer pursuant to this Contract, whether of material or work, and whether performed prior to, during or after completion of construction, are performed solely for the purpose of determining general conformity of the work with the Contract Plans and Specifications.

Nothing contained herein shall create, or be deemed to create:

1. any duty upon the Engineer to supervise the construction procedures and safety procedures followed by any Contractor or Subcontractor or their respective employees or by any other persons at the job site, or

2. any liability whatsoever by the Engineer to any employees or any Contractor or Subcontractor or to any other person.

00 07 51.03 NO WAIVER OF RIGHTS

A. No inspection or approval by the Owner, the Engineer, or any of their employees, nor any order, measurement or certification by the Engineer, nor payment for, nor acceptance of the whole or any part of the work by the Owner or the Engineer, nor any order of the Owner for payment of money, nor any possession taken by the Owner, nor any extension of time shall operate as a waiver of any provision of the Contract, or of any right to damage herein provided or of any power herein reserved. Neither shall a waiver of any breach of the Contract be construed to be a waiver of any other or subsequent breach. All remedies in the Contract shall be construed as being cumulative, in addition to each and every other remedy herein contained. The Owner shall have any and all legal and equitable remedies and recourse which they would in any case have.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 52

INSURANCE, SECURITIES AND GUARANTEES

00 07 52.01 GUARANTEES, PERFORMANCE BONDS, LABOR AND MATERIALS PAYMENT BONDS AND GUARANTEES

A. The Contractor shall furnish Performance and Labor and Materials Payment Bonds each in an amount not less than the full amount of the accepted bid. The Performance Bond shall guarantee faithful performance of the work in compliance with all Contract Documents. The Labor and Materials Payment Bonds shall guarantee the payment of all persons performing labor or furnishing materials in connection therewith. The Bonds shall be in a form approved by the Owner and dated the same as the executed Agreement. The Surety company or companies shall be designated by the Contractor and shall be authorized to transact business in New York State, and if this is a Federally aided project, shall appear on the U.S. Treasury Department's most current list (Circular 570 as amended). The premium for these Bonds shall be paid by the Contractor and shall be included as a part of their Bid. An Attorney-in-fact who signs Performance or Labor and Materials Payment Bonds shall file with each Bond or copy thereof a certified copy of their Power-Of-Attorney to sign such Bonds.

B. Cash in the form of United States currency or a certified check payable to the Owner in the full amount of the accepted Bid, deposited with the Owner, will be accepted in lieu of both Bonds. Such deposit shall serve as the Performance, and Labor and Materials Payment Bonds for all purposes specified, and the Contractor agrees that such deposit, or such portion thereof as may be required to satisfactorily complete the work, shall be forfeited to the Owner.

C. The Owner reserves the right to order or approve additions to, omissions from, or changes in the work without notice to the Surety.

D. The Contractor guarantees all the work, materials and equipment called for in the Contract against defects in materials or workmanship for a period of twelve months following the date of the Notice of Substantial Completion. Under this guarantee, the Contractor shall make good, at their own expense and without delay, any failure of any part due to poor or faulty materials, construction or installation, or to the failure of any equipment to satisfactorily perform the work required of it by the Specifications. The Contractor shall also make good any damage to any part of the Project, the environment or other property of the Owner caused by such failure. Any work replaced or rebuilt during the above-mentioned guarantee period shall be similarly guaranteed for a 12-month period starting from the date of acceptance of the repair, reconstruction or replacement.

E. The Contractor's Performance and Labor and Materials Payment Bonds specified in the above paragraph shall fully cover all guarantees specified.

00 07 52.02 ADDITIONAL SECURITY

A. At any time the Owner may become dissatisfied with the Surety or Sureties who furnished the Performance Bond and the Labor and Materials Payment Bonds, or if for other reasons the Bond(s) shall, in the opinion of the Owner, cease to be adequate security to the Owner, the Contractor shall, within five days after notice from the Owner, substitute a new Bond(s) acceptable to the Owner in form, amount and Surety. The premium on such Bond(s) shall be paid by the Contractor. No payments on any Monthly Estimate shall become due and none shall be made until the new Surety shall have been approved and the Bond(s) executed and accepted.

00 07 52.03 CONTRACTOR'S INSURANCE

A. The Contractor, at their own expense, shall procure and maintain until one year after the date of the Notice of Certificate of Substantial Completion or one year after the Contractor or any Subcontractor last performs any work under the Contract, even if the Project is abandoned or deferred, insurance for liability for damages required by law of the kinds and in the amounts stated herein and as may be modified by provisions in the Additional Instructions, through insurance companies authorized to operate in New York State. The insurance shall cover all operations necessary to complete the work, whether performed by the Contractor or Subcontractors. Before starting work, the Contractor shall furnish the Owner one duplicate original policy and five certificates of insurance for each and every type of insurance required.

B. All liability insurance required by this Contract shall be maintained in force during the term of this Contract and until one year after the date of the Notice of Substantial Completion or one year after the Contractor or any Subcontractor last performs any work under the Contract, even if the Project is abandoned or deferred.

1. Commercial General Liability Insurance — $1,000,000 Occurrence
   Bodily Injury & Property Damage — $2,000,000 Aggregate

2. Automobile Liability
   Bodily Injury & Property Damage — $1,000,000 Combined Single Limit

3. Umbrella Liability — $4,000,000 Occurrence
   $4,000,000 Aggregate

4. Workers Compensation & Employers Liability — Statutory

C. Additional Insured – Contractor shall name Contractor, Owner, the Engineers and any other entity required by contract as additional insured on all liability policies except Workers Compensation and Owners, Contractors Protective Liability with respect to all operations under the Contract by the Contractor, Subcontractor, including suspension and omissions of the Owner. The additional insured status shall be on a primary and non contributing basis over all other valid and collectible insurance, with respect to this Contract.

D. Additional Conditions

1. Waiver of Subrogation: The Contractor and Subcontractors waive all rights against (1) each other and any of their subcontractors, agents and employees, each of the other, and (2) the Owner, the Engineer, the Engineer's consultants, separate contractors, and any of their subcontractors, sub-subcontractors, agents and employees for damages caused by bodily injury, property damage, fire or other causes of loss to the extent covered by insurance provided under the Contract or other insurance applicable to the work, except such rights as they may have to proceeds of such insurance held by the Owner as a fiduciary. The Subcontractor shall require of the Subcontractor's sub-subcontractors, agents and employees, by appropriate agreements, written where legally required for validity, similar waivers in favor of the parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

2. Commercial General Liability (CGL):

a. Coverage with limits of Insurance of not less than $1,000,000 each occurrence and $2,000,000 Annual Aggregate.
b. If the CGL coverage contains a General Aggregate Limit, such General Aggregate shall apply separately to each project/location.
c. CGL coverage shall be written on ISO Occurrence Form CG 00 01 1093 or a substitute form providing equivalent coverage and shall cover liability arising from premises, operations, independent contractors, products-completed operations, and personal and advertising injury and contractual liability.
d. Contractor, Owner and all other parties required of the Contractor, shall be included
as additional insureds on the CGL. Coverage for the additional insureds shall apply as Primary and noncontributing Insurance before any other insurance or self-insurance, including any deductible, maintained by, or provided to, the additional insureds.

e. Contractor and Subcontractor shall maintain CGL coverage for itself and all additional insureds for the duration of the project and maintain Completed Operations coverage for itself and each additional insured for at least one year after Contractor or Subcontractor last performs any work under the Contract.

3. Auto Liability:

a. Business Auto Liability with a combined single limit of at least $1,000,000 each accident.
b. Business Auto coverage must include coverage for liability arising out of all owned, leased, hired and non-owned automobiles.
c. General Contractor, Owner, Engineers and all other parties required of the General Contractor, shall be included as additional insureds on the auto policy.

4. Umbrella Insurance:

a. Umbrella limits must be at $4,000,000 each occurrence and $4,000,000 aggregate.
b. Umbrella coverage for such additional insureds shall apply as primary before any other insurance or self-insurance, including any deductible, maintained by, or provided to, the additional insured other than the CGL, Auto Liability and Employers Liability coverages maintained by Contractor.

5. Workers Compensation and Employers Liability:

a. Statutory for New York State. All other states Employers Liability/Insurance limits of at least $500,000 each accident for bodily injury by accident and $500,000 each employee for injury by disease.

6. Property Insurance (Builders Risk):

a. The Contractor shall provide and maintain, at their own expense, such property insurance as required by Contract. Policy(s) shall provide cover for fire, extended cover including open (special) perils and theft to insure all work and materials of the Contract against loss or damage. The value of the insurance shall at all times be equal to or greater than the full value of the Contract. Insurance policies shall be in the name of the Owner and payable to the Owner. Any proceeds there to shall be retained by the Owner as security for the performance by the Contractor in making good any loss, damage or injury. Upon such satisfactory performance by the Contractor, the proceeds shall be paid by the Owner to the Contractor.

E. Owners, Contractors Protective Liability Insurance

1. Owners Protective Liability Insurance at the limits stated in the Additional Instructions issued in the name of the Owner to and covering the liability for damages imposed by law upon the Owner with respect to all operations under the Contract by the Contractor or their Subcontractor, including supervisory acts and omissions of the Owner. Unless otherwise stated in the Additional Instructions, a minimum of $1,000,000 per occurrence / $2,000,000 aggregate is required.

F. Insurance Certificates

1. Attached to each certificate of insurance shall be a copy of the Additional Insured Endorsement that is part of the Commercial General Liability Policy. These certificates and the insurance policies required shall contain a provision that coverage afforded under the policies will not be cancelled or allowed to expire until at least 30 days prior written notice has been given to the Contractor/Owner.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 53

STATUS OF CONTRACTOR

00 07 53.01 REPRESENTATIONS OF CONTRACTOR

The Contractor warrants and represents that:

A. They are familiar with all Federal, State, County and Municipal laws, ordinances, regulations and codes pertinent to the work and those employed in connection therewith, including any special acts relating to the work or the Project.

B. They have carefully examined all the Contract Documents and the Site and has, thereby satisfied themselves as to: the location and nature of the work; the quantity, quality and nature of both surface and subsurface structures and materials apt to be encountered; the quantity, quality and types of plant, equipment and other facilities necessary for the performance of the work; the general and local conditions; and all other matters which may in any way affect the work or their performance under the Contract.

C. Such work, both temporary and permanent, required under the Contract can be satisfactorily constructed and used for its intended purpose, without injury to any person or damage to any property.

D. They are financially solvent and experienced in and competent to perform the work of the Contract.

E. If a corporation foreign to the State of New York, they are aware of the provisions of Article 13 of the Business Corporation Law, with specific reference to the requirements in Section 1301 that certain corporations may not do business in this State without first obtaining a certificate of authority from the Secretary of State.

F. If a corporation, they are aware of the provisions of Article 145 of the Education Law, with specific reference to the requirements and prohibitions of Section 7209 relating to the practice of professional engineering, or the use of the word "engineer" or "engineering" in a corporate name.

00 07 53.02 ADDRESS OF CONTRACTOR

A. Both the address given in the bid and the Contractor's office at or near the Site, if such is established, are designated as places to either of which letter, notices, or other communications to the Contractor may be mailed or delivered. The delivery at either place, or the depositing, in a post-paid wrapper addressed to either place, in any regularly maintained U.S. Post Office Box, of any letter, notice, or other

communication shall be deemed sufficient service thereof upon the Contract. If at any time during the life of the Contract, it is necessary to change either address, the Contractor shall give written notice to the Owner, the Surety and the Engineer.

B. Nothing herein shall act to prevent or invalidate the personal delivery in hand of any letter, notice or other communication to the Contractor.

00 07 53.03 PATENTS

A. The Contractor shall pay, as part of this Contract, all costs and fees required to obtain the legal right to use patented equipment, designs, or procedures to be used, as part of the work on this Contract.

B. The Contractor shall defend, indemnify, keep and save harmless the Owner from all costs, damages, liabilities, judgments and expenses, including reasonable attorney fees which may in any way arise against the Owner because of the use of any patented material, equipment or process furnished or used in the performance of the work or because of the use of patented designs supplied by the Contractor and accepted by the Owner.

C. If any claim, suit or action at law or inequity of any kind involving any such patent is brought against the Owner, the Owner may retain from any moneys due or to become due to the Contractor an amount considered sufficient by the Owner to protect itself against loss until such action is settled and satisfactory evidence to that effect has been supplied to the Owner.

00 07 53.04 CONTRACTOR'S OBLIGATIONS

A. The Contractor shall furnish all the plant, machinery, labor, equipment, material, tools, appliances, shoring, bracing and scaffolding necessary to the proper and safe completion of the work in the manner specified, shown and directed within the time specified. They shall suitably cover the work whenever necessary, and otherwise protect it from damage from any cause whatsoever.

B. If in the opinion of the Engineer the Contractor's procedures or appliances appear at any time, either before or during progress of the work, to be inadequate or insufficient to provide the quality of the work, or the rate of progress specified, they may order the Contractor to improve their character and increase their sufficiency, and the Contractor shall comply therewith. However, failure of the Engineer to issue such an order shall not relieve the Contractor of their obligations to secure the safety, quality or progress of the work, and the Contractor alone shall be responsible for the safety, adequacy and efficiency of their methods, plant and appliances.

00 07 53.05 LIABILITY FOR INJURIES OR DAMAGE

A. The Contractor shall be solely responsible and liable for the safety and protection of all persons, including but not limited to the Owner, Engineer, Contractor and Subcontractor and their employees, suppliers and visitors, and shall be solely responsible and liable for the safety and protection of property, including but not limited to the Site and its appurtenances and equipment, and they shall be solely responsible for all physical injuries, including death, to any such persons and for all damage to any such property and its appurtenances, which occurs on account of the work, or because of any negligence, fault or default of the Contractor, a Subcontractor or any of their officers, employees or agents.

B. The Contractor shall have on the project site at all times, while work is in progress, at least one person skilled in safety and health procedures and familiar with State and Federal safety and health regulations whose responsibility shall be to observe methods and procedures. They shall have the duty and authority to stop and/or correct all unsafe and unhealthy conditions.

00 07 53.06 GENERAL INDEMNIFICATION

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

00 07 53.07 CONTRACTOR'S CLAIM FOR DISPUTED WORK

A. If the Contractor believes they or their Subcontractor or anyone directly or indirectly employed by any of them has sustained damage for disputed work, for which they claim they should be compensated, they shall give written notice to the Engineer, describing the nature and circumstances of the disputed work, within seven days after sustaining such damage. The Contractor shall also file with the Engineer, within 30 days of the date on which the alleged damage occurred, an itemized statement of the character and amounts of such damage. Unless both statements shall be filed as so required, the claim for compensation shall be considered invalid and the Contractor shall not be entitled to any payment therefor.

B. The Contractor shall proceed diligently with performance of the disputed work pending final resolution of their claim for damages.

C. During the progress of such disputed work, the Contractor shall provide to the Engineer daily records and make reports of all labor, material and equipment used in connection with such work and the cost thereof as specified in Section 00 07 57.03.

D. If the Owner determines that the work in question is Contract work and not a Changed condition, they shall direct the Contractor to continue the disputed work, and the Contractor must promptly comply.

E. If the Owner determines that the work in question is not Contract work and is a Changed condition, they shall direct the Contractor to continue the work and shall have prepared a Change Order in accordance with Section 00 07 57.03.

00 07 53.08 NO CLAIMS AGAINST INDIVIDUALS

A. No claim shall be made by the Contractor or their Subcontractor or anyone directly or indirectly employed by any of them against any officer, employee or agent of the Owner and the Engineer for, or because of, anything done or failure to be done in connection with the work.

00 07 53.09 CONTRACTOR'S TITLE TO MATERIALS

A. Neither the Contractor nor any Subcontractor shall purchase any materials, equipment or supplies for work subject to any chattel mortgage or under a conditional sale agreement or other agreement by which an interest is retained by the seller. The Contractor shall obtain and maintain good and clear title to all materials and supplies used by them in the work until attachment to or incorporation in the work.

B. Nothing in the Contract shall be construed as vesting in the Contractor any property right in materials or equipment specified after they shall have been attached to or incorporated in the work or the ground, nor in materials and equipment for which partial payments have been made. All such materials and equipment shall become the property of the Owner upon such attachment or incorporation.

00 07 53.10 TITLE TO OLD MATERIALS

A. All materials removed from existing structures or construction, and all materials or articles of intrinsic or historic value found in excavations or on the Site shall be brought to the attention of the Engineer, and if they shall so order, shall become or remain the property of the Owner, and shall be carefully preserved for future use. If not claimed by the Owner, such materials or articles shall be removed from the Site and disposed of by the Contractor at their own expense.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 54

CONTRACTOR'S ORGANIZATION & STAFF

00 07 54.01 SUPERINTENDENTS, FOREMEN & AGENTS

A. The Contractor shall at all times, except during periods of shut-down or work suspension that have been approved or directed, have a competent superintendent, foreman or other representative on the Site, who shall see that the work is performed in accordance with the Contract Documents and directions of the Engineer given thereunder, and who shall have authority to act for the Contractor and to receive and carry out orders from the Engineer, and who shall receive materials and equipment shipped to the Contractor. The Contractor shall be responsible for the acts of their superintendents, foremen, agents and employees during the life of the Contract.

00 07 54.02 COMPETENCY & CHARACTER OF EMPLOYEES

A. The Contractor shall employ only competent and skillful persons to perform the work. This provision shall apply equally to common laborers and skilled craftsmen or tradesmen.

B. Whenever the Engineer informs the Contractor that any person on the work is, in the Engineer's opinion, incompetent, intemperate, unfaithful, insufficiently skillful, or disorderly, or refuses to carry out the provisions of the Contract, or to stop doing unsatisfactory work when so ordered, or who uses threatening or abusive language to, or engages in offensive, hostile, or harassing conduct toward the Owner, Engineer, or any authorized representative(s) thereof, such person shall be discharged from the work by the Contractor and shall not again be employed without written consent of the Engineer.

00 07 54.03 CONTRACTOR'S FIELD OFFICE

A. Unless waived by provisions within Additional Instructions, the Contractor shall provide, furnish and maintain for their own use a field office, with telephone, on the Site during the entire period of construction. The Contractor shall obtain approval of the Engineer of the type, size and location of such office, shanties or other temporary structures on the Site, prior to their erection.

B. The Contractor will receive no direct payment for providing, maintaining or removing the Contractor's Field Office specified above, and compensation for same shall be included, as part of their overhead, in the prices to be paid for the various items in this Contract.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 55

PERMITS, TAXES, ACCESS, OTHER CONTRACTS

00 07 55.01 LAWS, REGULATIONS & PERMITS

A. The Contractor shall procure at their own expense all necessary permits from the Federal, State, County, Town, municipal or other public agencies that may be involved in the work or the Project or have jurisdiction thereover, and shall serve all notices required by law or ordinance and pay all fees and charges incidental thereto. They shall at all times keep themselves fully informed of all laws, ordinances and regulations which in any way affect the work, the materials, methods and equipment used in the work, the conduct of the work, and persons engaged or employed on the work, and of all orders, instructions and decrees of bodies, agencies or tribunals having any authority or jurisdiction over the work or the Project.

B. If the Contractor should discover any discrepancy or inconsistency in any Contract Documents relating to any permit, law, ordinance, regulation, code, order, decree or instruction, they shall immediately report the same in writing to the Engineer.

C. The Contractor shall at all times observe and comply with all such existing and all laws which come into existence during the execution of the Contract, as well as permits, codes, decrees, ordinances, regulations, orders and instructions, and shall cause their superintendents, foremen, employees and agents to do likewise.

00 07 55.02 REQUIRED LEGAL PROVISIONS DEEMED INCLUDED

A. All clauses and provisions of law required by law to be included in the Contract shall be deemed to be included herein, and the Contract shall be interpreted, administered and enforced as though they were included. If, through oversight or otherwise, any such clause or provision is not included, or is not correctly included, the Contract shall immediately be physically amended or corrected, at the request of either party, to provide the necessary compliance.

B. The inclusion in the Contract Documents of any portion of any law or ordinance or code, regulation, decree, order, permit, instruction or interpretation emanating from a public body or agency, shall not be construed to mean that all such laws or legal requirements deemed necessary, in effect, or applicable to all or any portion of the work or the Contract have been included.

00 07 55.03 UNLAWFUL REQUIREMENTS DEEMED EXCLUDED

A. If the Contract Documents contain any unlawful provision not an essential part of the Contract and which shall not appear to have been a controlling or material inducement to the making of the Contract by the parties thereto, such provision shall be construed to be of no effect and shall, upon written notice by either party, be deemed stricken from the Contract without affecting the binding force of the remainder on both parties.

00 07 55.04 TAXES

A. The Contractor shall pay all sales, use, excise, transportation and other taxes and fees for which they are liable under the Contract. The cost of such taxes and fees shall be included in the price, or total of several prices, given in the Bid on which the Agreement is based, and no separate payment will be made therefor.

00 07 55.05 ACCESS TO WORK AND CONTRACTOR'S RECORDS

A. The Owner and the Engineer, and their employees, agents and representatives, shall have access to the work, the Site, and the premises used by the Contractor, and the Contractor shall provide and maintain safe and suitable facilities therefor. Subcontractors, and any other parties who may contract with the Owner to do work on the Site shall, for all purposes which may be required by their contracts, have the same privileges and facilities.

B. Whenever requested, the Contractor shall give the Engineer access to invoices, bills of lading, trip tickets, lists of employees, survey notes and other such data connected with the work.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 56

TIME ELEMENTS

00 07 56.01 COMMENCEMENT & COMPLETION

A. The Contractor shall begin performance of the work within the time specified in the Information for Bidders, and shall substantially complete the work within the time specified in the Information for Bidders.

00 07 56.02 TIME OF ESSENCE

A. Since the provisions of this Contract relating to the commencement and completion of the work are to enable the Owner to construct and place in use an improvement or facility in accordance with a pre-determined program, such provisions are of the essence of this Contract. It is agreed that the Owner will suffer damages if the work is not completed in the time specified.

00 07 56.03 PROGRESS

A. The rate of progress shall be as uniform as practicable and such that all the work will be completed within the time specified, or within any time extensions that may be granted by the Owner.

B. The Engineer will notify the Contractor in writing if, at any time, they are of the opinion the work is unnecessarily delayed and will not be completed on time. The Contractor shall, within 10 days after receipt of such notice, take such action as will, in the opinion of the Engineer, improve the rate of progress to an extent that will insure completion of the work within the time specified. If the Contractor shall fail or refuse to take such steps within 10 days, the Owner may notify the Contractor to stop work or terminate the Contract in accordance with the provisions of Article 00 07 60.01, OWNER'S RIGHT TO STOP WORK OR TERMINATE CONTRACT.

00 07 56.04 APPROVED WORK SCHEDULES

A. Unless waived by provision in the Information for Bidders, within three weeks after award of the Contract, the Contractor shall submit to the Engineer for approval three copies of their proposed work schedule. The schedule shall show the Contractor's proposed relative order and sequence of commencement and completion of all salient portions of the work, including the delivery and installation of equipment, and shall give the estimated dates of commencement and completion of the various portions of the work.

B. If more than one Contract is to be awarded on the same phase of the project, the General Contractor shall provide the Engineer with additional copies of their work schedule after the schedule shall have been approved. The Engineer will transmit these to the other Contractors for reference in the preparation of their proposed work schedules and submittal of same for approval. In such case each Contractor other than the General Contractor shall submit their proposed schedule for approval within three weeks after receipt of a copy of the General Contractor's approved schedule.

C. Each Contractor shall adhere to the approved schedule for their Contract. If a Contractor causes one or more other Contractors to be damaged by failing to adhere to their schedule, they shall save harmless the Owner and the Engineer from any and all actions and charges of the other Contractors against the Owner or the Engineer as the result of such failure.

D. If the Contractor is behind schedule any month, the Contractor shall indicate what measures it will take in the next thirty (30) days to put the work back on schedule. If the Engineer finds the revised schedule not acceptable they may require the Contractor to submit a new revised schedule.

E. If the Contractor fails to submit a work schedule within the time period described or any revision or update when required, the Owner may withhold payment pursuant to Section 00 07 59.07 of the Contract until such time as the Contractor submits the required work schedule.

F. See also Article 00 10 12.01, COLLATERAL WORK.

00 07 56.05 WORK SUSPENSION

A. When, in the opinion of the Engineer, good cause of suspension of the work exists, the Contractor shall suspend the work or any portion thereof, upon written order of the Engineer, for such period of time as the Engineer may direct. If the reason for suspension is beyond the control of the Contractor, the time within which the work is required to be completed shall be extended by the number of calendar days the work is suspended.

00 07 56.06 TIME EXTENSIONS

A. Should the work be obstructed or delayed through the neglect, delay or default of any other Contractor on the Project, or by an Act of God, or by a general strike, or by delays caused by governmental authorities having jurisdiction over the work, or by delay on the part of the Owner in performing any work or furnishing any material or equipment stated in the Contract to be furnished by the Owner, or by any Supplementary Agreement or Change Order issued by the Owner, the Contractor shall have no claim for damages against the Owner or the Engineer, other than the price or prices agreed upon under Supplemental Agreement, or Change Order, but shall be entitled to such an extension of time for completion of

the work as the Engineer certifies is equitable because of such obstruction, delay, Supplemental Agreement, or Change Order, provided that claim for a time extension is made by the Contractor, in writing within seven days from the end of the time when the alleged cause therefore shall have occurred. Time necessary for Shop Drawing review, for changes to meet actual conditions, and delays incurred by seasonal and weather limitations for the locality should be normally anticipated and are neither compensatory nor eligible for extensions of time. See also ARTICLE 00 10 12.01, COLLATERAL WORK, and 00 07 57.03, CHANGE ORDERS AND PAYMENT OR CREDIT THEREFOR.

00 07 56.07 ENGINEERING AND INSPECTION CHARGES

A. When the work embraced in the Contract is not substantially completed on or before the date specified therein, or within any time extensions granted by the Owner, engineering and inspection expenses incurred by the Owner in connection with the work from the specified or extended date of substantial completion until the date of actual Substantial Completion shall be charged to the Contractor. The date of actual substantial completion shall be determined as the date of issuance of the Notice of Substantial Completion.

B. Supplementary Agreements or Change Orders added to the original Contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the Owner prior to assessing engineering and inspection charges against the Contractor.

C. In addition, should the Contractor apply for and receive dispensation to work more than eight hours per day or forty hours per week by the Industrial Commissioner, the Contractor will be charged the associated overtime premium rate for the Engineer's on-site inspection representative(s).

D. Should the remaining minor punch list items not be completed within sixty (60) days of the Notice of Substantial Completion or within any time extensions granted by the Owner, the Contractor shall pay the Owner for any engineering and inspection expenses incurred by the Owner from the specified or extended date of minor punch list completion until when such punch list items are fully complete.

E. These additional engineering and inspection charges shall be in the form of agreed-upon damages to the Owner and shall be deducted from moneys due or to become due the Contractor.

00 07 56.08 PER DIEM CHARGES FOR DELAY

A. For each calendar day or fraction thereof that any work except minor punch list items as listed on the Notice of Substantial Completion shall remain uncompleted after the Contract time specified for the substantial completion of the work in the Information For Bidders or extensions thereof granted by the Owner, the Contractor shall pay the Owner agreed-upon damages as follows, unless modified in the Additional Instructions:

Original Contract Amount		Agreed-Upon Damages
From More Than	To and Including	Per Calendar Day
$ 0	$ 25,000	$ 50
$ 25,000	$ 50,000	$ 100
$ 50,000	$ 100,000	$ 200
$ 100,000	$ 500,000	$ 300
$ 500,000	$ 2,000,000	$ 500
$ 2,000,000	$ 5,000,000	$ 600
$ 5,000,000	$10,000,000	$ 800
$10,000,000		$1,000

B. The date of actual Substantial Completion shall be determined as the date of issuance of the Notice of Substantial Completion.

C. Such sums shall be in addition to engineering and inspection charges as provided for in ARTICLE 00 07 56.07 and shall not be in the nature of a penalty, but agreed-upon damages to the Owner in such case and shall be a part of the consideration of the Contract.

D. The sums and charges specified above shall be deducted from moneys due or to become due the Contractor and the amount still owing, if any, shall be paid on demand by the Contractor or the Surety. Such payments shall not relieve the Contractor or the Surety from any other obligation under the Contract.

E. Before assessing engineering and inspection charges, or per diem charges for damages, the Owner will give due consideration to any and all Supplementary Agreements and Change Orders as well as extenuating circumstances beyond control of the Contractor including any delays due to any preference, priority or allocation order duly issued by the Government. Such charges will be assessed, however, in cases in which the Owner considers the Contractor liable as the result of slow work, inefficient operation, insufficient labor, equipment or material, the removal and replacement of poor work, or other unwarranted reasons.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 57

CHANGES IN THE WORK

00 07 57.01 RIGHT TO ALTER CONTRACT

A. The Owner may at any time alter or modify the Contract Documents, and the Contractor shall conform to such alterations or modifications after the Owner and the Contractor shall have entered into a Supplementary Agreement in writing therefor. The Contractor shall perform no work and furnish no material in connection with the alterations or modifications, nor shall they receive any additional payment therefor, unless and until such a Supplementary Agreement has been executed, as required by law. The Owner and the Contractor agree that alterations and modifications thus made shall in no way compromise the validity or coverage of the original Contract or Bond, or the liability of the signers thereof. All work performed under any such Supplementary Agreement shall be subject to all the provisions of the original Contract not expressly altered or modified.

00 07 57.02 MINOR CHANGES

A. When ordered by the Engineer, the Contractor shall make minor changes in the location of the work, installation of equipment, and other things called for in the Contract, at no additional cost to the Owner. Such minor changes shall be limited to matters that do not alter the character, quantity or cost of the work as a whole. The Engineer shall be the sole judge of what constitutes a minor change.

00 07 57.03 CHANGE ORDERS & PAYMENT OR CREDIT THEREFOR

A. The Owner, without invalidating the Contract, may make changes by altering, adding to or deducting from the work the contract sum being adjusted accordingly. All such work shall be executed in conformity with the terms and conditions of the original Contract, unless otherwise provided in the order for same. Any claim for extension of time caused thereby shall be adjusted at the time of ordering such change.

B. No instructions, either written or verbal, shall be construed as an order for changes unless it be in the form of a Change Order, bearing the signed approval of the Owner and the signed acceptance of the Contractor, except in the case of disagreement as to value of changes, when the Contractor's signature to the order will not be mandatory. Change Order shall describe or enumerate the work to be performed and state the price, if any, to be added to or deducted from the Contract sum. If the nature of the work is such that a Change Order, as above, cannot be issued until the work has been advanced sufficiently to obtain exact quantities, said work will be authorized in writing by the Owner, with the accompanying

statement that a Change Order will be issued when the necessary information is at hand.

C. Except as provided in the above paragraph, no change shall be made, unless in pursuance of a Change Order, and no claim for an addition to the Contract sum shall be valid unless so ordered. If the Contractor believes that any instructions, by drawing or otherwise, involves extra cost under their Contract, they shall give the Owner and the Engineer written notice and then proceed as indicated in Article 00 07 53.07, Contractor's Claim for Disputed Work.

D. The value of any Change Order shall be determined by one or more of the following methods and in the following order:

1. By prices specifically named in the specifications or proposals.

2. By acceptance of agreed unit prices based on estimated cost plus overhead and profit as applicable.

3. By estimate of the actual cost of labor and materials plus overhead and profit, cost to be determined as the work progresses.

4. By actual cost of labor and materials plus overhead and profit, cost to be determined as the work progresses.

5. By estimate of the value as deducible from the approved detailed estimate.

E. Overhead shall be defined as an allowance to compensate for all costs, charges and expenses, direct or indirect, except for the actual cost of labor and material as defined by the following paragraph. Overhead shall be considered to include, but not be limited to insurance (other than as mentioned in the following paragraph) bond or bonds, field and office supervisors and assistants above the level of foreman, use of small tools and minor equipment, incidental job burdens, general office expense, etc.

F. Actual cost of labor and material shall be defined as the amount paid for the following items, to the extent determined reasonable and necessary.

1. Cost of materials delivered to the job site for incorporation into the Contract work.

2. Wage paid to workmen and foremen and wage supplements paid to labor organizations in accordance with current labor agreements.

3. Premiums or taxes paid by the Contractor for Worker's Compensation Insurance, unemployment insurance, FICA tax and other payroll taxes as required by law, net of actual and anticipated refunds and rebates.

4. Sales tax paid as required by law.

5. Allowance for use of construction equipment (exclusive of hand tools and minor equipment), as approved for use by the Engineer. The rate on self-owned equipment used for periods of under one week will be the Associated Equipment Distributor's published monthly rate divided by 22 days to establish a daily rate and divided again by eight hours to establish an hourly rate. Equipment used for periods of 5 days or more will be billed at a rate equal to 45% of the published monthly rate. In the alternative, the Engineer may approve for reimbursement a rate representing the allocable costs of ownership. Self-owned equipment is defined to include equipment rented from controlled or affiliated companies. Rented equipment will be paid for at the actual rental cost.

6. Gasoline, oil and grease required for operation and maintenance will be paid for at the actual cost. When, in the opinion of the Contractor, and as approved by the Engineer, suitable equipment is not available on the Site, the moving of said equipment to and from the Site will be paid for at actual cost.

7. When the material furnished under item (1) is used material, its value shall be pro-rated to the value of new material, but should be no more than its cost. When, in the opinion of the Engineer, the salvage value of salvageable material furnished under item (1) exceeds the cost of salvage, a suitable credit shall be given the Owner.

G. Regardless of the method used to determine the value of any change, the Contractor will be required to submit evidence satisfactory to the Engineer to substantiate each and every item that constitutes their proposal of the value of the change. The amounts allowed for overhead and profit shall not exceed the applicable percentages as established in the two following paragraphs.

H. If the work is done directly by the Contractor, overhead in an amount of 10% may be added if method B, C or D is used, and to the cost of the labor and materials plus overhead there may be added 10% for profit. The percentages for overhead and profit may vary according to the nature, extent and complexity of the work involved, but in no case shall exceed the percentages set forth in this paragraph and in the following paragraph. No percentages for overhead and profit will be allowed on payroll taxes or on the premium portion of overtime pay.

I. If the work is done by a Subcontractor, Subcontractor's overhead in the amount of 5% may be added to cost of labor and materials if method B, C or D is used and to the cost of labor and materials plus overhead there may be added 10% for the Subcontractor's profit. To this amount there may be added 10% for the Contractor's combined overhead and profit. No percentage for overhead and profit will be allowed on payroll taxes or on the premium portion of overtime pay. However, to the extent that the aggregate dollar value of changes under a contract exceeds $75,000, the 10% overhead applied to total costs of labor and materials incurred by the prime Contractor shall be reduced to 5%, and the combined

overhead and profit of 10% applied to sub-contract billings shall be reduced to 5%. In addition, on all individual Change Orders in excess of $75,000, the overhead shall be no more than 5% of the total actual cost of labor and materials incurred by the prime Contractor, and the combined prime Contractor's overhead and profit allowance applied to Sub-contract billings shall be no more than 5%.

J. The Owner shall determine by which of the foregoing methods the value of any changes shall be computed.

00 07 57.04 CORRECTION OF WORK

A. Any materials, plant or equipment delivered to the Site for use in the work which may be disapproved by the Engineer as unsuitable or not in keeping with the Specifications shall be immediately removed by the Contractor from the Site.

B. If any portion of the work is damaged in any way, or if defects or faults develop before the Inspection at Substantial Completion and issuance of a Certificate of Substantial Completion, or before the expiration of the 12-month guarantee period, the Contractor shall repair, replace or otherwise make good the damage or defects to the satisfaction of the Engineer, regardless of whether the work may have previously passed the specified inspections and tests. No additional payment will be made for such remedial work.

C. Failure on the part of the Engineer to condemn defective work shall not imply acceptance of the work, nor act to release the Contractor from their obligations to repair, replace or otherwise make good the work at their own expense, notwithstanding that such work may have been estimated for payment or that partial or full payments may have been made therefor.

00 07 57.05 EMERGENCY POWERS UNIMPAIRED

A. The provisions of this shall not detract from the authority of the Contractor or the Engineer to act in case of emergency, as provided elsewhere in the Contract Documents.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 58

ASSIGNMENT & SUBCONTRACTS

00 07 58.01 SUBCONTRACTS

A. Should the Contractor desire to subcontract any portion of the work, they shall first submit to the Engineer a statement outlining the nature and amount of the work proposed to be subcontracted and the name of the person, firm or corporation they proposes as Subcontractor. If requested by the Engineer, the Contractor shall also provide a statement as to the proposed Subcontractor's experience, financial ability, insurance certificates, or other qualifications for the nature and scope of the work proposed to be undertaken.

B. The proposed Subcontractor shall not enter upon the Site nor perform any work, either on or off the Site, until written approval of the Subcontractor has been granted by the Engineer and the Surety.

C. Subcontracts shall in no way, directly or indirectly, release, compromise or modify the responsibility of the Contractor or the Surety for the satisfactory and full completion of the work. The Owner shall not be liable to any Subcontractor for any lien on structures to be constructed as part of the work or claim on moneys due the Contractor or any other lien, claim or damages whatsoever. The approval of the Engineer and the Surety of a Subcontractor shall in no way create a contractual obligation between the Owner and the Subcontractor.

D. In the event a Subcontractor shall disregard the directions of the Engineer, or fail in any other way to abide by all conditions of the Contract, the Contractor shall, upon written order of the Engineer, require the Subcontractor to discontinue work under the Contract.

E. The Contractor shall be responsible for the coordination of all of their Subcontractors engaged upon the work, both in connection with their own work and the work of other contractors, if any, working collaterally on the Project.

F. The divisions or sections of the various Contract Documents and Bid Items are not intended to define portions of the work to be divided among Subcontractors, nor to influence the Contractor to award Subcontracts, nor to limit or enlarge the work performed by any trade, unless a Subcontractor experienced in providing a certain specialized type of work is specifically required in the Contract.

00 07 58.02 LIMIT OF SUBCONTRACTS VALUE

A. The Owner reserves the right to limit the total value of all Subcontracts to fifty (50) percent of the total Contract price.

00 07 58.03 ASSIGNMENT

A. In accordance with the provisions of Section 109 of the General Municipal Law of the State of New York, the Contractor shall not assign, convey, transfer, sublet or otherwise dispose of this Contract, or of their right, title or interest therein, or their power to execute such Contract, to any other person or corporation without the prior written consent of the Owner.

B. If the Contractor shall, without such consent of the Owner, assign, convey, transfer, sublet or otherwise dispose of this Contract to any other person or corporation, the Owner may revoke and annul the Contract, in which instance the Owner shall be relieved and discharged from any and all liability and obligations to the Contractor arising from the Contract, and to the persons or corporation to which the Contract shall have been assigned, conveyed, transferred, sublet or otherwise disposed of, and the Contractor and their assignees, conveyees, transferees or sublessees shall forfeit and lose all moneys theretofore earned under such Contract, except so much as they may be required to pay their employees.

C. Nothing herein shall prevent an assignment by the Contractor for the benefit of their creditors made pursuant to the laws of the State of New York.

00 07 58.04 PAYMENT

A. Payment to Subcontractors and/or material suppliers shall be in accordance with Section 106b of the General Municipal Law of the State of New York.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 59

PAYMENTS

00 07 59.01 ESTIMATED QUANTITIES

A. The Contractor agrees that the estimated quantities given in the Bid are only for the purpose of comparing bids and that they are satisfied with and will at no time dispute the said estimates as a means of comparing the aforesaid bids, that they will make no claim for loss of profits or anticipated profits because of any difference between the said estimated quantities and the quantities of the various classes of work actually furnished or performed, that the Owner shall not be held responsible if any of the said estimated quantities should be found to not even approximate those actually measured during performance of the work, and that the Engineer may direct an increase, decrease or omission of the quantities of any class or part of the work as may be deemed necessary or desirable.

00 07 59.02 PRICES ALL-INCLUSIVE

A. The price or prices herein agreed to shall be for the work complete, and shall include the furnishings of all labor, tools, plant, equipment and materials therefor, whether required directly or indirectly, unless otherwise specified.

00 07 59.03 LUMP SUM PRICES

A. A lump sum price stated in the Bid for an item shall be for the work complete as shown on the Plans and described in the Specifications for the corresponding item and shall include the cost of all labor, tools, plant, equipment and materials, specified or implied, incidental to the work of the item complete and ready for the service intended.

B. Within three weeks after execution of the Contract, the Contractor shall submit to the Engineer for approval three copies of a detailed schedule showing the breakdown of all lump sum bid prices in the Contract. The schedule shall indicate the quantities and amount estimated for each part of the work. The schedule shall be apportioned by the Contractor for labor and for materials, if so requested by the Engineer. The Contractor shall revise the schedule until it is satisfactory to the Engineer. The approved breakdown will be used in the preparation of monthly estimates and payments to the Contractor.

00 07 59.04 UNIT PRICES

A. A unit price stated in the Bid for an item of the work specified to be measured for payment by units of volume, weight, area, length or number shall be paid for each unit of the net amount of the work of the item actually performed or furnished and incorporated in the finished work in accordance with the Specifications, Plans and as directed, as measured along the payment lines specified or shown, local custom to the contrary notwithstanding. It is agreed that the planimeter shall be considered an instrument of precision for the measurement on drawings and plans of areas in connection with the estimation of quantities in cases where geometric methods would be comparatively laborious.

00 07 59.05 MONTHLY ESTIMATES AND PAYMENTS

A. Unless otherwise noted in the Additional Instructions or the Specifications once each month, on a day of the month selected by the Engineer, they will make an estimate of the value of the work done during the previous month, provided such value exceeds one thousand dollars. The Engineer shall submit this Monthly Estimate to the Owner for payment. The Owner will pay the Contractor each month, within 30 days of the date of the Monthly Estimate, a sum equal to ninety-five (95) percent of the Monthly Estimate, retaining five (5) percent of each estimate until the work or major portions thereof is substantially completed.

B. The work will be considered Substantially Complete when the work of the Contract including all alterations or modifications (see Section 00 07 57 - CHANGES IN THE WORK) is at least ninety-nine (99) percent complete and the estimated value of minor items to be completed is equal to or less than one (1) percent.

C. The Engineer will include in the Monthly Estimates the delivered cost of equipment and non-perishable materials on site and off site which have been tested or inspected by the Engineer and approved by them for incorporation in the work. Only equipment and materials for which the Contractor furnishes the Engineer receipted invoices as evidence that they have unconditional title thereto will be included. Such invoices shall be furnished the Engineer at least ten days in advance of the established date of preparation of Monthly Estimates.

D. The Contractor shall provide and maintain insurance for the said equipment and materials (on site and off site) as specified in 00 07 52.03.

E. Payments made for materials and equipment delivered will in no way affect the Contractor's responsibilities regarding the same.

00 07 59.06 WITHDRAWAL OF RETAINED PERCENTAGE

A. Pursuant to Section 106 of New York State General Municipal Law and notwithstanding any inconsistent provisions of any general, special or local law under any contract made or awarded by any political subdivision, or any officer, board or agency thereof, or of any district therein, the Contractor may, from time to time, withdraw the whole or any portion of the amount retained from payments to the Contractor pursuant to the terms of the Contract, upon depositing with the Fiscal Officer of the Political Subdivision or district therein (1) bonds or notes of the United States of America, or obligations, the payment of which is guaranteed by the United States of America, or (2) bonds or notes of the State of New York, or (3) bonds of any political subdivision of the State of New York, of a market value equal to the amount withdrawn. The Fiscal Officer of the Political Subdivision or of a district therein, from time to time shall pay the same, when and as collected, to the Contractor who deposited such obligations. When the deposit is in the form of coupon bonds, the coupons shall be delivered to the Contractor as they respectively come due. The Contractor shall not be entitled to interest or income on, or the coupons of, any obligations so deposited by them, the proceeds of which shall have been used or applied by the Political Subdivision or district therein pursuant to the terms of the Contract. The Fiscal Officer shall be entitled to charge a reasonable fee for such service.

00 07 59.07 OWNER'S RIGHT TO WITHHOLD PAYMENTS

A. The Owner may withhold from the Contractor such portions of any approved payments due them as the Owner may judge necessary to:

1. Protect the Owner from loss due to defective work not remedied;

2. Failure to provide work schedule or revisions thereto;

3. Assure the payment of just claims then due and unpaid for labor or materials;

4. Protect the Owner from loss due to injury to persons or damage to the work or property of other Contractors, Subcontractors, or others caused by acts of neglect of the Contractor or their Subcontractors. The Owner shall have the right as agent for the Contractor to apply moneys so withheld as the Owner may deem proper to secure such protection or satisfy such claims, and such payments shall be deemed made for the account of the Contractor.

00 07 59.08 INSPECTION AT SUBSTANTIAL COMPLETION

A. The Engineer will make an Inspection of the work as soon as possible after the Contractor gives written notice that the work is substantially complete. The Contractor shall assist the Engineer, as may be required, in making the Inspection. Cost to the Contractor, if any, to assist the Engineer in making the Inspection shall be included in the appropriate bid item as selected by the Contractor and no additional payment will be made to the Contractor for their work. After making the Inspection, the Engineer will notify the Contractor in writing of the results, including particulars regarding any part of the work which, in their opinion, is incomplete or requires correction or additional cleaning. The Contractor shall make good any incomplete or defective work before again asking for another Inspection. If in the opinion of the Engineer the work is substantially complete, the Engineer shall issue in writing a Notice of Substantial Completion. Said Notice will list those minor items requiring completion before Final Payment.

B. See also ARTICLE 00 07 57.04, CORRECTION OF WORK.

00 07 59.09 CERTIFICATE OF SUBSTANTIAL COMPLETION

A. Upon issuance of the Notice of Substantial Completion by the Engineer, and the submission by the Contractor of a written statement from Surety that the Performance Bond (Labor & Materials Payment Bonds included) in the amount of one hundred (100) percent of the value of the Contract is in force for a period of one year following the date of Notice of Substantial Completion, the Engineer will file a Certificate of Substantial Completion with the Owner and the Contractor, certifying that the work is substantially complete and setting forth the amount of work performed and compensation earned by the Contractor. All prior estimates of the amount and value of work performed shall be subject to correction in this certification.

00 07 59.10 PAYMENT AT SUBSTANTIAL COMPLETION

A. Within 30 days after the filing of the Certificate of Substantial Completion the Owner will pay the Contractor one hundred (100) percent of the full value of the work certified therein, less twice the value of any minor work remaining to be completed and all prior payments and advances to or for the account of the Contractor, and the amount necessary to satisfy any claims, liens or judgements against the Contractor which have not been discharged.

00 07 59.11 FINAL PAYMENT

A. The Contractor shall fully complete the remaining minor items within sixty (60) days of the issuance of the Notice of Substantial Completion.

B. Upon certification by the Engineer that the remaining items of the Contract including all corrections, alterations and/or modifications have been completed and that no repairs, renewals or replacements are required of the Contractor, or that, if required, such remedies have been effected, the Engineer shall prepare a Final Payment request recommending to the Owner payment to the Contractor of the amount retained at the time of substantial completion less any amount necessary to satisfy any claims, liens or judgements against the Contractor which have not been discharged.

C. Within 30 days after the receipt from the Contractor of acceptable affidavits, certificates or waivers as evidence that no right to any claim or lien exists, the Owner will pay the remainder of the Contract as indicated in the Final Payment.

D. See also Article 00 01 50.06, VERIFICATION OF AMOUNTS DUE FOR WAGES AND SUPPLEMENTS.

00 07 59.12 ACCEPTANCE OF FINAL PAYMENT

A. Acceptance by the Contractor of the Final Payment shall serve as a release to the Owner of all claims and of all liability to the Contractor for all things done or furnished in connection with the work, and for any and all acts of neglect of the Owner or others relating to or because of the work, except the Contractor's claim for interest upon the Final Payment, if this payment is unduly delayed. No payment whatsoever shall operate to release the Contractor or the Surety from their obligations under the Contract or Bond.

00 07 59.13 GUARANTEE INSPECTION

A. On or about one year from and after the date of the Notice of Substantial Completion, the Engineer will again inspect the work. The Contractor shall assist the Engineer, as may be required, to make the one year inspection. Cost to the Contractor, if any, to assist the Engineer in making the one year inspection shall be included in the appropriate bid item as selected by the Contractor and no additional payment will be made to the Contractor for this work. The Contractor shall provide any and all repairs, renewals or replacements which may be revealed as necessary in this Guarantee Inspection and which, in the opinion of the Engineer, are the responsibility of the Contractor. Should the Contractor fail to comply with written instructions of the Engineer regarding these remedies, the Owner will cause the remedies to be made by others and will pay the cost which will be reimbursed by the Contractor and/or their Surety.

B. The Contractor and their Surety agree that the Contractor's Performance Bond (Labor & Materials Payment Bonds included) shall cover fully all guarantees as specified herein and in ARTICLE 00 07 52.01.

00 07 59.14 ACCEPTANCE OF PORTIONS OF THE WORK

A. The Owner reserves the right to accept for their service and use any portion of the work at any time during the life of the Contract without prejudice to the Owner in enforcing any provisions of the Contract.

B. The Owner may accept the portion or portions of the work which is substantially complete under the following agreed procedures:

1. The Contractor will be notified by the Engineer in advance as to what portion or portions of the work the Owner intends to accept for their use and service.

2. The retained percentage for the Substantially Completed portion or portions of work shall be released in accordance with ARTICLE 00 07 59.09.

3. The guarantee period applicable to that portion or portions of the work shall start from the date of acceptance.

4. The remaining minor items of the portion or portions of substantially completed work shall be finished or corrected to the satisfaction of the Engineer.

5. The Owner will assume responsibility for maintenance, heat, utilities and insurance on accepted portion or portions of the work.

6. All applicable provisions specified in this Section for work deemed substantially complete shall apply.

00 07 59.15 REPAIR OR REPLACEMENT OF DAMAGED, DEFECTIVE OR FAULTY WORK

A. If any portion of the work is damaged in any way, or if defects or faults develop before the inspection at Substantial Completion, or before the expiration of the 12-month guarantee period, the Contractor shall repair, replace or otherwise make good the damage or defect to the satisfaction of the Engineer, regardless of whether the work may have previously passed the specified inspections and tests. No additional payment will be made for such remedial work.

B. Failure on the part of the Engineer to condemn defective work shall not imply acceptance of the work, nor act to release the Contractor from their obligations to repair, replace or otherwise make good the work at their own expense,

notwithstanding that such work may have been estimated for payment or that partial or full payments may have been made therefor.

00 07 59.16 PAYMENT TO SUBCONTRACTORS BY CONTRACTOR

A. Within fifteen calendar days of the receipt of the payment from the Owner, the Contractor shall pay the Subcontractors, and/or material suppliers a sum equal to the value of the work performed less any amount necessary to satisfy claims, liens or judgements that have been discharged less any amount retained as hereafter described.

1. The retained amount shall not exceed more than 5% on each payment except that 10% of each payment may be retained, if the Subcontractor(s) and/or material suppliers failed to provide a Performance Bond (Labor & Materials Payment Bonds included) in the full amount of the Sub-contract.

2. The Contractor shall not retain any money from Subcontractor(s) and/or material suppliers, after receipt of the Certificate of Substantial Completion payment.

B. Within fifteen calendar days of the receipt of the payment from the Contractor, the Subcontractor(s) and/or material suppliers shall pay each of their Subcontractors and/or material suppliers in same manner as the Contractor has paid the Subcontractor(s) and/or material suppliers.

C. The Owner shall not be under any obligation to see that the Contractor makes any payment to a Subcontractor and/or material suppliers.

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 60

CONTRACT TERMINATION

00 07 60.01 OWNER'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

A. The Owner, by seven days written notice to the Contractor and without prejudice to any other rights or remedies it may have, may terminate the employment of the Contractor and their right to proceed, either as to the entire work or any portion thereof on which delay shall have occurred, and may take possession of and complete the work by contract or otherwise, as the Owner may deem expedient, in the event of any of the following:

1. If the Contractor shall refuse or fail, after being warned by the Engineer, to supply enough competent workmen, equipment or proper materials, or

2. If the Contractor shall refuse or fail to perform the work or any part thereof with sufficient diligence to insure its completion within the time specified, or shall fail to complete the work within said period, or

3. If the Contractor shall fail to promptly pay persons supplying labor or materials for the work, or

4. If the Contractor shall fail or refuse to regard laws, ordinances, permits or orders from the Engineer or otherwise substantially violate any provision of this Contract, or

5. If the Contractor shall be adjudged bankrupt or make an assignment for the benefit of creditors, or

6. If a receiver or liquidator shall be appointed for the Contractor or for any of their property and shall not be dismissed within 20 days after such appointment, or the proceedings in connection therewith shall not be stayed on appeal within the said 20 days.

B. If the Owner so terminates or stops the Contractor, the Contractor shall not be entitled to receive any further payment until the work is completed. If the unpaid balance of moneys to be paid the Contractor hereunder shall exceed the cost of completing the work, including the cost of additional administrative, managerial, engineering, and inspection services and or delay, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor and the Surety shall be liable to the Owner for the excess.

C. If the right of the Contractor to proceed is terminated as provided herein, the Owner may take possession of and use in completing the work such materials,

plant, equipment, supplies and appliances as may be on the Site and necessary to the work, provided that the termination was not made pursuant to paragraphs "E" or "F" above.

00 07 60.02 CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

A. In the event the work shall be halted by order of a Court or any other public authority having jurisdiction for a period of 90 days or more without act or fault of the Contractor or any Subcontractor, the Contractor, upon 10 days written notice to the Owner, may terminate the Contract or discontinue performance of the work. In either case the liability of the Owner to the Contractor shall be determined as provided in ARTICLE 00 07 60.01, except that the Contractor shall not be obligated to pay to the Owner any excess of the cost of completing the work over the unpaid balance of the payments to be made to the Contractor hereunder.

00 07 60.03 OTHER TERMINATION PROVISIONS

A. In addition to the provisions set forth in this Section 00 07 60, specific references relating to termination or cancellation of the Contract are contained elsewhere herein. These include but are not limited to:

00 01 50.03	NON-DISCRIMINATION AND LABOR PRACTICES
00 07 52.03.A	WORKER'S COMPENSATION INSURANCE
00 07 56.03	PROGRESS
00 07 58.03	ASSIGNMENT

END OF SECTION

GENERAL CONDITIONS

SECTION 00 07 61

DESCRIPTION & DELINEATION OF THE WORK

00 07 61.01 INTENT OF PLANS AND SPECIFICATIONS

A. The intent of the Plans, Specifications and other Contract Documents is to provide for the work outlined and delineated therein, complete in every detail for the purpose designated. The Contractor agrees to furnish everything necessary for the work as intended, any omission in the Plans or Specifications notwithstanding.

B. The Contractor shall furnish all materials, tools, plant equipment and labor, except those specifically set forth herein as to be furnished by the Owner, required to construct and place in complete and satisfactory working order the work contemplated by the Contract Documents. The mention in any part of the Specifications of any specific liability, duty or responsibility of the Contractor will not be construed as a restriction, limitation or waiver of any general liability, duty or responsibility of the Contractor, such mention being merely for explanatory purposes. The Contractor shall be solely responsible for the adequacy of their plant, tools and equipment, approval of the Engineer notwithstanding.

C. The Contractor shall do the work in a manner judged to best promote rapid construction consistent with due regard for the safety of life and the preservation of property, the satisfaction of the Engineer, and the intent of the Contract Documents.

D. The Contractor shall:

1. make all necessary excavations or embankments.
2. do all clearing and grubbing.
3. place all sheeting, shoring, bracing and supports.
4. furnish all underdrains.
5. provide draining, pumping bailing, ditching and diking for surface or below ground water.
6. provide all things necessary to protect, support and maintain structures, utilities, drains, conduits, culverts, trees, fences, poles, walls, earth banks, shrubbery, sidewalks, railways, roadways and drives.
7. repair all damage done to items in (6) above.
8. do all fencing, lighting and watching.
9. drive all piles and construct all foundations.
10. construct all concrete, brick, stone, tile and timber work.
11. place all iron and steel work and reinforcement.

12. lay all water pipes, sewers, drains and conduits and make all connections to or between such.
13. resurface and repave all streets, sidewalks, roads or drives open cut or damaged.
14. refill all trenches and excavations.
15. provide all fences, bridges, fills, detours and signs for maintenance of travel in public ways.
16. make all connections to or between existing structures and utilities.
17. construct all buildings and structures.
18. furnish and install equipment.
19. clean up and dispose of all rubbish and surplus materials.

00 07 61.02 INTERPRETATION OF PLANS & SPECIFICATIONS

A. The Engineer shall interpret the Plans and Specifications, and any Change Orders or Supplemental Agreements. Anything shown on the Plans but not included in the Specifications, or mentioned in the Specifications but not shown on the Plans, shall have the same effect as if set forth in both. In the event of a conflict between the Plans and Specifications, the Specifications shall govern. The attention of the Engineer shall be called to any discrepancies, as required by ARTICLE 00 13 40.06.

00 07 61.03 CONTRACT DRAWINGS

A. The location, nature and many details of the work are shown on the Contract Drawings. The work shall be constructed as shown on these Plans and such other drawings as may be issued during the life of the Contract by the Engineer, or furnished by the Contractor and approved by the Engineer.

B. The purpose of the Contract Drawings together with other Contract Documents, is to provide Bidders with sufficient information to prepare adequate and equitable Bids and to provide an adequate and equitable basis for the Agreement. The Contract Drawings may or may not provide sufficient detail for the actual construction of all segments of the work as shown and specified. The Contractor shall furnish Construction Drawings or other drawings, as specified or requested, or, as may be required to adequately delineate for their workers all details necessary for the work.

C. The Contract Drawings were prepared on full-size prints. Reduced-size prints may have been prepared for the convenience of Bidders and others. During construction, the Contractor shall obtain data and information from full-size prints in preference to reduced-size prints.

D. Unless otherwise stated in the Information For Bidders, the Contractor will be furnished, free of charge, three copies of the Contract Documents, including three sets of Contract Drawings. Any other copies of the Contract Documents which

the Contractor may desire can be obtained by their from the Engineer at the cost of duplication thereof.

E. The Contractor shall keep at least one set of Specifications and one full-size set of Plans on the Site, and shall at all times give the Engineer and the Owner access thereto.

00 07 61.04 ADDITIONAL OR SUPPLEMENTAL DRAWINGS

A. The Engineer may prepare Additional Drawings or Supplemental Drawings during the course of the work, in connection with minor changes, Change Orders, Supplemental Agreements, or to augment or amplify the Contract Drawings or other drawings, or as part of orders or instructions, and the Contractor shall abide by such drawings in the same manner as specified for the Contract Drawings.

B. Drawings required by the Contractor are discussed in Article 00 13 40.01.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 10 12

COLLATERAL WORK

00 10 12.01 COLLATERAL WORK

A. The Owner may award other contracts in connection with the Project, the work under which may proceed concurrently with the work of this Contract. In this event the Contractor shall coordinate their operations with those of the other contractors, and shall cooperate with them in the arrangement for the storage of materials and performance of the work.

B. The Contractor and their Subcontractors shall keep themselves informed of the progress of the work of other contractors and subcontractors and shall notify the Engineer immediately of defective workmanship or insufficient progress on the part of others, where such will interfere with their own operations. Either failure of the Contractor to keep themselves informed of the progress of work under other contracts on the Site, or failure of the Contractor to give proper notice of same, shall be deemed as acceptance by them of the status of the work under other contracts as it may affect their own work.

C. See also ARTICLE 00 07 56.04, APPROVED WORK SCHEDULES, and ARTICLE 00 07 56.06, TIME EXTENSIONS.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 10 15

CONTRACTOR USE OF PREMISES

00 10 15.01 AREA AVAILABLE FOR CONTRACTOR'S USE

A. The Contractor shall confine their operations to those portions of the Owner's property, and to the right-of-ways or easements, temporary or permanent, acquired or designated for the work of the Contract as shown on the Drawings. Private property adjacent the Site shall not be entered upon or used by the Contractor for any purpose without the written consent of the Owner thereof. A copy of such consent shall be filed with the Engineer.

B. When required, the Contractor shall provide and maintain fences at their own expense, along the roadways and around the grounds occupied by them for the protection of adjoining property and all persons lawfully using same. Fences shall be of materials and construction suitable in the opinion of the Engineer for their intended purpose.

C. All work within or abutting private property shall be performed in such ways as to create the minimum of inconvenience and disturbance to the private property and its users. Excavated materials or supplies of any kind shall not be stored on off-site public or private property without written consent of the Owner thereof, and all walks and drives shall be kept open to uninterrupted passage. A copy of each such written consent shall be filed with the Engineer.

D. Materials delivered upon public streets shall be neatly stored between the sidewalk and the curb or ditch line, and at least 10 feet from any fire hydrant. A passageway of at least three feet shall be preserved on the sidewalk line.

00 10 15.02 TRAVEL NOT OBSTRUCTED

A. The Contractor shall not needlessly hinder or inconvenience travel on any public or private way, nor shall they wholly obstruct same without written permission of the Owner. If they are permitted to obstruct a traveled way, the Contractor shall provide plain and appropriately worded signs and adequate barricades and lighting at the nearest cross streets, and at each end of the obstructed portion, announcing such obstruction and directing traffic to and along an approved detour.

B. Unless otherwise specified or permitted, all entrances and exits of fire houses, industrial plants, commercial buildings and public buildings shall be kept open and maintained in passable condition at all times. The Contractor shall give notice to the owner of each traveled way before interfering therewith.

00 10 15.03 CLEANING UP

A. The Contractor shall remove from the Site and dispose of, at their own expense, all rubbish, refuse and unused materials, as the work progresses. If such work is neglected, the Engineer will give written notice thereof to the Contractor. If the work is not performed within five days thereafter, the Owner will employ other persons to do such work, and the expense thereof shall be deducted from any monies due or to become due the Contractor.

B. The Contractor shall clean and leave free from obstruction all pipes, buildings, manholes and other structures. This work shall be coordinated with the Engineer's Inspection at Substantial Completion, or as directed. All rubbish, refuse, unused materials, plant and equipment shall be removed from the Site, and the entire Site shall be left in a neat condition. All equipment installed in the work by the Contractor shall be cleaned and left in a bright and new-appearing condition.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 10 19

SITE CONDITIONS

00 10 19.01 PRE-BID INSPECTION & EXAMINATION

A. The Contractor warrants and represents that they visited the Site prior to submitting their Bid, and that they have satisfied themselves as to the location and nature of the work and the quantity, quality, type and nature of both surface and subsurface structures and materials apt to be encountered.

B. See also 00 07 53.01.B.

00 10 19.02 BORINGS

A. Any data on subsurface conditions that may have been obtained by the Owner prior to the advertisement for bids, through test borings, test pits, seismic explorations, or other means, was obtained by the Owner for their sole use and only for their own purposes. Any such data, known or recalled as of the date of advertisement for bids, are shown on separate drawings or in separate schedules and reports which are <u>not</u> any part of the Contract Documents. All such data are made available to Bidders, the Contractor and other interested parties only as a convenience and without express or implied representation, assurance or guarantee that any of the information is complete, correct, or adequate or representative of a true or typical picture of subsurface conditions on the Site.

B. The Contractor, both during their status as Bidder and after execution of the Contract, shall satisfy themselves as to the nature, character, quality and quantity of above ground and below ground conditions apt to be encountered. Any reliance on data made available by the Owner shall be at the Contractor's sole risk.

C. No claim whatsoever shall be made by the Contractor against the Owner or Engineer for or on account of such data available, or neglected to be made available, by the Owner or Engineer.

D. The Contractor at any time, and any holder of Contract Documents during the period between advertisement for and receipt of bids, will be permitted to make test borings, test pits, soundings or similar subsurface investigations on the Site. Prior to making these investigations the Contractor and/or any holder of Contract Documents must notify the Engineer when and where they propose to make such investigations.

E. The locations where test boring samples, if any, may be examined are given in the Additional Instructions.

F. See also ARTICLES 00 07 53.01.B, 00 07 53.07, 00 07 59.01, 00 10 19.04 and 00 10 19.06.

00 10 19.03 PROTECTION OF EXISTING STRUCTURES

A. The Contractor shall at all times have on the Site suitable and sufficient plant and materials to adequately protect, support and sustain any and all existing structures and facilities, whether above or below ground, and shall use same as may be necessary or required to protect, support and sustain any and all such structures as may become weakened, endangered, undermined or uncovered.

B. They shall, at their own expense, support and sustain in their places and protect from direct or indirect damage all water, gas, steam, air or other mains or pipes, sanitary and storm water sewers and drains, conduits, subways, service connections, buildings, poles, wires, fences, pavements, sidewalks, curbs, railways, trees and other structures and property and appurtenances thereto on or in the vicinity of the Site, and shall assume all liability for damage thereto, including damage arising out of settlement or lateral movement of walls of excavations, whether occurring during performance of the work or the 12-month period of guarantee.

C. In the event of damage or danger to any such structure or facility the Contractor shall immediately notify the Engineer, and shall promptly repair or protect the structure as the Engineer may direct.

00 10 19.04 EXISTING STRUCTURES BELOW GROUND

A. The Contract Drawings show the location and character of certain existing subsurface structures and facilities apt to be encountered in excavations or located in such proximity to the work as to require precautions for their protection. The sizes, materials, locations and depths shown are only approximate, and the Contractor shall satisfy themselves as to the accuracy and completeness of such information. The Contractor shall not be relieved from any of their obligations, nor be entitled to claim for damages or additional compensation, sustained or arising out of inadequacy or inaccuracy of the information given.

00 10 19.05 ABANDONED STRUCTURES

A. Any structures, facilities or appurtenances therefor which are abandoned or become so by reason of the work, shall, at the Contractor's expense, be broken up and filled with approved material, if directed by the Engineer.

00 10 19.06 LATENT SUB-SURFACE CONDITIONS

A. In the event that latent sub-surface conditions are found to materially differ from those on which the Plans and Specifications are based, the Contractor shall immediately notify the Engineer before they are disturbed. After prompt investigation, the Engineer will determine what changes, if any, should be made in the Plans and Specifications because of the revealed conditions, and shall instruct the Contractor accordingly. Any change in the cost of the work resulting therefrom shall be adjusted as provided in Section 00 07 57.

00 10 19.07 ADJUSTMENT OR CHANGES OF EXISTING STRUCTURES

A. If, in the opinion of the Engineer, an underground pipe or other structure requires realignment or relocation, and such realignment or relocation was not included in the Plans or Specifications, the Engineer will issue a Change Order for such work, and the Contractor shall be compensated therefor as provided in Section 00 07 57. The Contractor shall strip or uncover and support or sustain the structure at their own expense prior to such Change Order, as part of their work under the original Contract, and they shall not be entitled to claim for damage or delay due to its presence or discovery.

B. Wherever existing utilities come within limits of the work, the Contractor shall notify both the Engineer and the Utility before in any way disturbing same. Any work of realignment, relocation, removal or extension of the utilities shall be done as mutually agreed by the Utility, the Contractor and the Engineer. The Contractor shall maintain satisfactory drainage of the excavation at all times from revelation of the structure until completion of its realignment or readjustment. Interruption of service by utilities shall be kept to a minimum.

C. The Contractor shall not cause nor permit interference with or hindrance to any municipal department, individual, public service corporation, or other company in protecting its structures and facilities, nor in removing, replacing or relocating same.

00 10 19.08 MAINTENANCE AND RESTORATION OF SERVICE

A. The Contractor shall, at their own expense, provide for the maintenance of flow in all water courses and all sanitary and storm sewers, drains, connections and appurtenances thereto. The contents of sewers, drains or service connections shall not be permitted to flow into excavations, sewers or other parts of the work without written permission of the Engineer, and the Contractor shall, at their own expense, immediately remove from the Site and adequately dispose of all offensive matter, in an approved manner.

B. The flow of water, and normal water pressure, in all water mains, conduits and service connections encountered on the Site, shall be provided for and maintained by the Contractor at their own expense. When water mains or service connections

must be disturbed to the extent that service must be shut off, the Contractor shall give at least 24 hours notice to the Utility and all customers served by the lines involved. Such notice shall give the estimated times of shut-off, and restoration of service. If fire hydrants are involved, the fire department serving the area shall be similarly notified.

C. In the event of accidental disruption of water service, it shall be deemed an emergency, and the Contractor shall proceed with the necessary repairs immediately and continuously, giving this work priority over all other operations, until service has been satisfactorily restored. The Contractor shall give immediate notice of such break or service interruption to the Engineer, the Utility, and all customers affected, and shall supply, at their own expense, assistance in supplying an emergency source of water when necessary by means of temporary lines, tank trucks, or other means. All lines and connections shall be restored to the satisfaction of the Engineer and the Utility.

D. All portions of the foregoing provisions regarding water service which are applicable to sewer, gas, telephone or other services shall apply also to maintenance and emergency repair of such services.

00 10 19.09 POLES & POSTS ON-SITE

A. Poles or posts of any Utility located within the lines of the work which, in the opinion of the Engineer, will impede progress of the work, shall be supported or removed and replaced by the Contractor at their own expense and in accordance with the requirements of the Utility involved. The Contractor shall remove, relocate, replace or support all other poles and posts at their own expense and to the satisfaction of the Engineer.

B. The Contractor shall employ no equipment which will unduly interfere with wires or other overhead facilities.

00 10 19.10 NOTIFICATION OF OTHER PARTIES

A. In addition to notices to Utilities and others required elsewhere herein, the Contractor shall give written notice of their proposed construction operations to the owners of all public and private utilities at least seven days in advance of breaking ground in any area in which a utility is located. Copies of each such notice shall be simultaneously sent to the Engineer.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 10 51

LAYOUT OF WORK

00 10 51.01 INFORMATION PROVIDED BY ENGINEER

A. The Engineer will provide, on the Contract Drawings, sufficient information for the Contractor to establish baselines, offsets and other survey control points. Unless otherwise noted, no additional survey work will be provided by the Engineer.

00 10 51.02 SERVICES PROVIDED BY CONTRACTOR

A. Unless otherwise noted in the Additional Instructions or Specification, the Contractor will establish such additional lines, grades and elevations as they deem necessary and will include the following:

1. Structures & Buildings: Corner stakes at all principal corners of exterior walls or foundations. Two bench marks in the vicinity of the structure or building.

2. Sewers: Offset grade line stakes, on one side, with stations approximately forty linear feet on centers.

3. Water Mains & Force Mains: When laid to grade, the same as for sewers. When not laid to grade, none.

4. Roads & Runways: Offset center line grade stakes, on one side, with stations approximately fifty linear feet on centers.

5. Embankments: Slope stakes on both sides at approximately one hundred linear feet on centers, with additional stakes at principal breaks in grade.

6. Tunnels & Borings: Center line and offset baseline on the surface, on starting end. Also, one progress check every fifty linear feet of long tunnels.

7. Other Types of Construction: The Contractor will provide control stakes as they deem necessary to properly layout their work.

8. On Traverse or Cross-country type of construction, such as pipelines and roads, a temporary center line may be required for clearing purposes.

9. The Contractor will issue a grade letter for pipeline and road construction which is to be laid or installed to a predetermined grade. All other stakes will have the information marked on a witness stake beside the hub.

B. The Contractor shall provide all the necessary materials for control points, including all: stakes, hubs, lath, grade boards, cleats, nails and such other materials as may be required.

C. The Contractor shall also provide such non-technical assistance as may be required in the establishment of marks, other than primary or basic controls, such as clearing sight lines and driving stakes.

D. The Contractor shall erect and establish all grade boards, batter boards and construction control lines from the information provided by the Engineer.

E. The Contractor shall layout the work to best suit their methods of operations, using the Engineer's information provided to assure the construction will be in the position the design anticipated.

00 10 51.03 OBLIGATIONS OF THE CONTRACTOR

A. The Contractor shall carefully preserve and protect all stakes, marks, monuments and points provided or described by the Engineer, and shall reimburse the Owner for any and all additional engineering costs incurred because of the replacement or reestablishment of any such items which may be moved, removed, obliterated or destroyed due to their construction operations. When directed, the Contractor shall provide suitable barricades for the protection of points.

B. The Contractor shall bear the entire cost of rectifying work improperly done due to their own negligence in preserving and protecting marks, or to moving or removing same without approval of the Engineer.

C. They shall inform the Engineer a reasonable time in advance of their operations of the times and places they propose to work, so that lines, grades and elevations may be established and necessary measurements for record and payment may be made with the minimum of inconvenience or delay to either themselves or the Engineer. No additional compensation will be paid the Contractor for any delay caused by insufficient notice.

00 10 51.04 LINES, GRADES AND ELEVATIONS

A. The terms "invert" or "grade" used in the Contract Documents in connection with pipes, sewers, channels, flumes and similar structures shall mean the inside bottom of the pipe or other surface on which the liquid flows along the center line of the completed work. "Subgrade" refers to the bottom line or surface to which excavations are necessarily made to construct the work as shown or specified,

exclusive of any additional depth of excavation required for any special foundation.

B. The term "Grade Letter" shall mean a data sheet giving the amount of cut or fill from offset stakes to the invert or grade.

C. All work shall be constructed in accordance with the lines and grades shown, specified or directed. The Contractor shall be responsible for maintaining alignment and grade between points provided or described on the Contract Drawings.

00 10 51.05 MASONRY CHASES, OPENINGS AND INSERTS

A. If the Owner awards other contracts for collateral work on the Site, it shall be the obligation and responsibility of the General Contractor to provide all openings and chases in their work to fit both their own work and that of the other contractors. The General Contractor shall provide all openings shown on the Contract Drawings, or reasonably implied thereby, as confirmed or modified by Additional Drawings or drawings submitted by Contractors and approved by the Engineer.

B. Where pipes or conduits pass through slabs or walls, the sleeves or opening forms shall be provided by the installer of the pipes or conduits but shall be placed by the General Contractor.

C. If hanger inserts or similar items are required, they shall be furnished by the installer of the pipe or other equipment for which the hangers are intended, but shall be placed by the General Contractor.

D. Any expense resulting from mislocated, defective, or ill-timed work shall be borne by the Contractor responsible therefor. No Contractor shall alter the work of another Contractor without the consent of the Engineer and knowledge of the Contractor involved, and no Contractor shall endanger any work by cutting, excavating or other operations.

00 10 51.06 PAYMENT FOR LAYOUT OF WORK

A. The cost to the Contractor of providing the services and materials specified in this Section 00 10 51 shall be included in the price, or total of prices, given in the Bid on which the Agreement is based, and no separate payment will be made therefor. Any cost to the Owner for additional engineering layout work, as set forth in ARTICLE 00 10 51.03, will be deducted from monies due or to become due the Contractor.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 10 64

SAFETY AND HEALTH

00 10 64.01 SAFETY AND HEALTH REGULATIONS

A. The Contractor shall comply with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standard Act (PL 91-54), latest revisions.

B. In order to protect the general public and the lives and health of their employees under the Contract, the Contractor shall comply with all pertinent provisions of the latest issues of the Federal Register, Bureau of Labor Standards, Safety and Health Regulations; New York State Industrial Code Rule 30 pertaining to Tunneling Operations; New York State Industrial Code Rule 23 pertaining to Trenching Operations; and the "Manual of Accident Prevention in Construction" issued by the Associated General Contractors of America, Inc., and shall maintain an accurate record of all cases of death, occupational disease, and injury requiring medical attention or causing loss of time from work, arising out of and in the course of employment on work under this Contract. In case of a conflict between the above noted authorities, the most stringent shall prevail.

C. The Contractor shall have on the project site at all times, while work is in progress, at least one person skilled in safety and health procedures and familiar with State and Federal safety and health regulations whose responsibility shall be to observe methods and procedures. They shall have the duty and authority to stop and/or correct all unsafe and unhealthy conditions.

00 10 64.02 SAFETY AND FIRST AID

A. The Contractor shall at all times exercise caution in their operations and shall be responsible for the safety and protection of all persons on or about the Site. All hazards shall be avoided or guarded in accordance with the provisions of the Manual of Accident Prevention in Construction of the AGCA, unless such provisions contravene local law. The safety provisions of all applicable laws, codes and ordinances shall be observed.

B. The Contractor shall provide and maintain at the Site, at each location where work is in progress, as part of their plant, an approved first aid kit. Ready access thereto shall be provided at all times when workers are employed on the work.

C. The Contractor shall take due precautions against infectious diseases, and shall arrange for the immediate isolation and removal from the Site of any employee who becomes ill or is injured while engaged on the work.

00 10 64.03 DUST HAZARDS

A. If, in the construction of the work covered by the Contract, a harmful dust hazard is created for which appliances or methods for the elimination of dust have been approved by the Board of Standards and Appeals, such appliances or methods shall be installed and maintained and effectively operated by the Contractor at their expense.

B. The Contract shall be void and of no effect unless the Contractor complies with the provisions of this subdivision of the Contract and Labor Law Section 222-a.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 13 40

SUBMITTALS

00 13 40.01 DRAWINGS FURNISHED BY THE CONTRACTOR

A. The Contractor shall prepare, or cause to be prepared by their suppliers or Subcontractors, and submit to the Engineer for review, Shop Drawings, Setting Drawings, Working Drawings and Construction Drawings as may be specified or directed or necessary to the performance of the work. Deviations from the drawings and specifications shall be called to the attention of the Engineer at the time of the first submission of Shop Drawings, or other drawings, for consideration. Corrections or comments made on the Shop Drawings or other drawings during review do not relieve the Contractor from compliance with the requirements of the Contract Drawings and Specifications. Approval is only for general conformance with the design concept of the Project and with information set forth in the Contract Drawings and Specifications. Contractor is responsible for dimensions to be confirmed and correlated at the job site, information that pertains solely to the fabrication process or to the means and methods of construction, coordination with the work of all trades, and performing all work in a safe and satisfactory manner. Approval does not modify Contractor's duty to comply with the Contract Documents.

B. Within thirty days of the execution of the Agreement, the Contractor shall submit a schedule of submittals which includes a complete list of products proposed for the work tabulated by Specification Section, including manufacturer or fabricator, model number or other identifying designation.

C. Shop, Setting or Working Drawings shall be submitted for each type and model of fabricated materials and equipment. They shall provide complete and accurate working dimensions, weights, assembly and sectional views, details necessary to coordinating the work, anchor bolt and installation plans and instructions, parts lists and descriptions, materials and finishes lists, lists of any tools and spare parts required, diagrams of control wiring and piping, the location, sizes and types of connections to other work or other items, and any other data required to comply with the Contract or provide the workmen and the Engineer with information necessary to complete and inspect the work.

D. Electrical equipment drawings and data shall show physical dimensions, installation details, elementary and connection diagrams for each motor controller, interconnection diagrams for all equipment, identification of components external to electrical equipment, the coordination of control circuits, and definition of the contract arrangement and control action of the primary and final control elements.

E. If the Contractor proposes to furnish and install equipment requiring a layout or arrangement materially changed from that shown on the Contract Drawings as illustrative of one acceptable arrangement, they shall submit, for review, drawings showing the proposed arrangement and the appertaining changes to wiring, piping, structures and other equipment.

F. Submittals such as pre-printed manufacturers' installation instructions, maintenance data, parts lists, test results, or similar informational material are not considered Shop Drawings and will not be reviewed. Any submittal not required or otherwise requested will be returned to the Contractor.

G. See also ARTICLE 00 13 40.08, ADDITIONAL ENGINEERING COSTS.

00 13 40.02 TRANSMITTAL, IDENTIFICATION AND RESUBMITTAL

A. Unless otherwise approved, all Shop Drawings shall be submitted electronically. The Contractor shall accompany all drawings and other data submitted to the Engineer with a letter of transmittal to the attention of the designated Shop Drawing coordinator for the project.

B. All drawings shall be suitably identified with the name of the Project, Contract Number, Contractor name, name of the equipment or materials manufacturer, specification section designation and item number (if applicable) date, and initials indicating approval of such submittal by the Contractor under the applicable specification.

C. If the Engineer makes comments or corrections, they will be noted on the drawings, or explained in a letter of transmittal, or both. The Contractor shall make any requested revisions or additions and resubmit the drawings in the same manner as for the initial submittal.

D. After the Engineer completes its review, the submittal will be marked with one of the following dispositions:
1. Approved
2. Approved as Noted
3. No Action Required
4. Revise and Resubmit
5. Not Approved

E. Submittals marked “Approved”: Submittals that conform to the Contract Documents without comment will be issued a disposition of “Approved”. The Contractor may order, fabricate, or ship the materials included in the submittal.

F. Submittals marked “Approved As Noted”: Submittals that conform to the Contract Documents with correction of minor clarifications or omissions will be issued a disposition of “Approved As Noted”. The Contractor may order,

fabricate, or ship the materials included in the submittal that incorporates the Engineer's comments.

G. Submittals marked "No Action Required": Informational submittals will be issued a disposition of "No Action Required", acknowledging to the Contractor the Engineer's receipt of the submittal.

H. Submittals marked "Revise and Resubmit": Submittals that include a named manufacturer or supplier, but contain insufficient information to determine conformance to the Contract Documents will be issued a disposition of "Revise and Resubmit". The Contractor shall make corrections to satisfy the deficiencies indicated and repeat the submittal procedure. The resubmittal shall conform to the submittal numbering procedure specified herein.

I. Submittals marked "Not Approved": Submittals that do not conform to the Contract Documents will be issued a disposition of "Not Approved". The Contractor shall revise the submittal to incorporated equipment or products that comply with the requirements of the Contract Documents.

J. Upon return of a submittal marked "Approved" or "Approved as Noted", the Contractor may order, ship or fabricate the materials so noted. A submittal marked "Approved as Noted" should not be resubmitted for further review. Submittals marked "Revise as Noted - Resubmit" include extensive corrections or corrections of major importance affecting other items and require the submittal to be amended and resubmitted for a final review. Submittals marked "Rejected - Resubmit as Specified" are reserved for materials or equipment which are unacceptable. The Contractor shall resubmit for materials or equipment which are acceptable and in accordance with the Specifications.

K. More than one resubmittal per material or equipment will be considered an additional cost to the Engineer which shall be reimbursed by the Contractor. Refer to Article 00 13 40.08 for method of reimbursement.

00 13 40.03 DELAY THROUGH TARDY SUBMITTAL

A. All submittals shall be made on such a schedule and at such time as to permit adequate review. The Contractor shall make due allowance for possible revisions and resubmittals. Delays caused by tardy submittal of drawings or data for review shall be the responsibility of the Contractor. No work covered by submitted drawings, or drawings specified to be submitted, shall be performed until such drawings and data have been reviewed.

B. See also ARTICLE 00 07 56.04, APPROVED WORK SCHEDULES.

00 13 40.04 CONTRACTOR RESPONSIBLE FOR ACCURACY

A. The Contractor shall be responsible for the accuracy and completeness of the drawings and other data they submit, for their conformity to the Plans and Specifications, and for the proper fit and clearance of all construction work.

B. The Owner retains for the Engineer the option to refuse to review submitted data that are improperly identified or incomplete or which have not been checked by the Contractor for compliance with the Contract Documents.

00 13 40.05 ADDITIONAL INSTRUCTIONS

A. The Engineer may from time-to-time issue additional instructions to the Contractor as may be necessary to amplify, augment, modify or clarify the Contract Documents. These may be in the form of drawings, specifications, interpretations, orders and instructions, and may be in connection with or made a part of a Supplemental Agreement, Change Order, or Minor Change.

B. See also SECTION 00 07 57, CHANGES IN THE WORK.

00 13 40.06 DRAWINGS TO BE CHECKED BY CONTRACTOR

A. The Contractor shall check all dimensions, quantities and representations in the Specifications, Contract Drawings, Additional Drawings and all Supplemental Agreements, Change Orders and Instructions, and shall immediately notify the Engineer of any and all errors, omissions, or discrepancies therein which they may find. The Contractor will not be permitted to take advantage of any such error, omission or discrepancy in any Contract Document or subsequent document, as full instructions will be provided by the Engineer in such case.

00 13 40.07 SUBSTITUTES AND "OR-EQUAL" ITEMS

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item, the Specification or description is intended to establish the type, function and quality required. Unless the Specification or description contains or is followed by words reading that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment may be accepted by the Engineer under the following circumstances:

1. "Or-Equal": If in Engineer's sole discretion an item of material or equipment proposed by Contractor is of similar quality and functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed equal items.

2. Substitute Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, it will be considered a proposed substitute item. Contractor shall submit sufficient information as provided below in advance to provide adequate time to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by the Engineer will include the following or as the Engineer may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor. If Contractor wishes to furnish or use a substitute item of material or equipment, Contractor shall first make written application to Engineer for review thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation of the proposed substitute will prejudice Contractor's achievement of Substantial Completion on time, whether or not the substitute for use in the work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for work on the project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which will be considered by Engineer in evaluating the proposed substitute. Engineer may require Contractor to furnish additional data about the proposed substitute.

00 13 40.08 ADDITIONAL ENGINEERING COSTS

A. In the event that the Contractor fails to submit acceptable Shop Drawings (i.e., Shop Drawings which are returned marked "Approved" or "Approved as Noted") within two submittals, further review of the Shop Drawings will be considered an Additional cost. Similarly, all Engineering Costs associated with the review of a substitution will be considered an Additional cost.

B. Additional Engineering Costs include redesign, additional Shop Drawing reviews, investigations, consultant fees and revisions to the Contract Documents required because of the proposed substitution. Additional Engineering Costs will be the total of:

1. Billing Rates Schedule
2. Direct Expenses Plus 10%
3. Consultant Fees Plus 10%

C. Additional Engineering Costs shall be deducted from Contractor Payments by the Owner, in accordance with the Agreement for Engineering Services between the Owner and the Engineer.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 15 06

WORK UNDER UNUSUAL CONDITIONS

00 15 06.01 WORK AFTER DARK

A. Unless specifically required elsewhere herein, the Contractor shall perform no work after dark except in emergencies. When time permits, they shall inform the Engineer in advance of such work and shall obtain the Engineer's approval. When time does not permit advance notice to the Engineer, they shall inform the Engineer at the earliest possible moment.

B. The placing of concrete shall be so scheduled as to be started early enough in daylight hours to allow sufficient time for the completion of the section under construction before dark, including the work of finishers.

C. When, in order to minimize interference with existing structures or utilities, or maintain traffic, it may, in the opinion of the Engineer, be expedient or necessary to do work after dark, such work shall be performed by the Contractor at no additional cost to the Owner, and the Contractor shall provide adequate lighting therefor.

00 15 06.02 WORK ON SUNDAYS OR HOLIDAYS

A. Unless specifically required elsewhere herein, the Contractor shall do no work on Sundays or locally recognized legal Holidays except in an emergency, and then shall confine their operations to only the work considered necessary to be performed at such time.

00 15 06.03 WORK IN STORMS

A. If required by the Engineer, masonry work and the mixing and placing of concrete shall be halted during rain storms, and all fresh work shall be immediately protected with suitable coverings. The Contractor shall keep a sufficient quantity of such coverings at the Site as part of their plant and equipment.

B. No paving, exterior painting, fine grading, seeding or roofing shall be done during rain or snow storms.

00 15 06.04 WORK IN COLD WEATHER

A. Certain Specifications contain provisions prohibiting the performance of certain work in cold weather, or outlining the conditions under which such work may be so performed. In the absence of specific mention elsewhere in the Contract Documents, the judgement of the Engineer shall govern in any case where temperature may adversely affect or prevent the performance of good work.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 15 10

SERVICES DURING CONSTRUCTION

00 15 10.01 SANITARY FACILITIES

A. The Contractor shall provide on the Site, at their own expense, one or more toilets, suitably screened from public observation for the use of all persons employed on the work. They shall be provided, maintained and removed, when directed, by the Contractor, in such quantity, locations and manner as approved by the Engineer. Contents shall be removed and disposed of in a manner and at such times as shall be approved. Chemical toilets are to be preferred.

B. The Contractor shall not permit or condone the committance of nuisances on or about the Site. Any employee found violating these provisions shall be discharged in accordance with the provisions of ARTICLE 00 07 54.02.

C. The Contractor shall comply with any and all sanitary regulations as may have been established for the locality.

D. If the Owner awards other contracts for collateral work on the Project, the provision of sanitary convenience shall be the responsibility of the General Contractor, and all such facilities shall be made available to other Contractors and all Subcontractors until the date of the Certificate of Substantial Completion of the General Contract. Each Contractor, however, shall be individually responsible for the acts of their employees and Subcontractors, and for all provisions of this Section after completion of the General Contract.

00 15 10.02 WATER

A. The Contractor shall provide at all times sufficient drinking water from an approved source and by approved means, for all persons having reason to be on the Site in connection with the work.

B. If an ample supply is owned or controlled by the Owner, and is available at or near the Site, such supply will be made available to the Contractor, subject at all times to the requirements of the Owner established therefor, and at a cost to the Contractor as determined by the current schedule of charges filed by the Utility for all customers. Permission to use the water must be obtained in writing.

C. If water is obtained from a public or private supply not owned or controlled by the Owner, the Contractor shall make such arrangement for service with the owners thereof as they may require.

D. Non-potable water for other than drinking purposes may be obtained at the Site from the ground or surface sources, at the Contractor's own expense. The water must, however, be suitable for the purpose intended and shall be approved by the Engineer. The Specifications, for instance, contain requirements for water for making concrete and mortar.

E. If the Owner awards other contracts for collateral work on the Project, it shall be the responsibility of the General Contractor to obtain potable water for drinking purposes, and such water shall be made available to all Contractors, until the date of the Certificate of Substantial Completion for the General Contract. Each Contractor, however, shall be individually responsible for providing potable water for their own employees and their Subcontractors after completion of the General Contract.

F. If the General Contractor provides water, whether potable or non-potable, for their own purposes during construction of the work, besides drinking water, such water shall be made available to other Contractors and their Subcontractors during the life of the General Contract. Removal of temporary facilities shall be by the General Contractor, but such installation and meters shall remain until need therefor by each Contractor has ceased, or until the date of the Certificate of Substantial Completion of the General Contract. Each Contractor shall provide their own services after completion of the General Contract.

00 15 10.03 TEMPORARY HEAT

A. If the Owner awards other contracts for collateral work on the Project, it shall be the obligation and responsibility of the General Contractor to provide and maintain temporary heat in all above ground structures, and in all below ground structures other than manholes and similar pipeline appurtenances, by means of portable electric, oil or gas-fired appliances. The General Contractor shall provide and pay for all fuel and electric power used by such appliances, and any wiring or connections required, and shall provide suitable smoke pipes or other devices to prevent the deposit of smoke or smudge on building components or equipment.

B. After their installation by the Heating & Ventilating Contractor, the permanent heating system facilities may be used for temporary heating purposes, the operation thereof, and any temporary wiring or piping required and all power consumed shall be the obligation and responsibility of the General Contractor, who shall also be responsible to the Heating & Ventilating Contractor for the repair of any damage of work of the Heating & Ventilating Contract suffered as the result of use by the General Contractor.

C. After enclosure of all spaces to be heated, except for doors, windows and similar apertures, temporary enclosures for all apertures shall be provided. Temperatures in the entirety of such spaces shall be continuously maintained at not less than 50oF between October 15 and May 15, unless written permission is granted otherwise by the Engineer. The General Contractor shall securely install on each

floor of each building near the center of the building, a suitable thermometer. Either the temporary or the permanent heating system shall be available for around-the-clock use during the season specified above.

D. The Owner will supply all heat after the date of the Certificate of Substantial Completion of the General Contract.

E. No portion of the Temporary Heat provisions herein contained shall be construed to waive or modify any provisions regarding maintenance of air or materials temperatures for the protection of the work contained elsewhere in the Contract Documents.

00 15 10.04 TEMPORARY ELECTRIC LIGHT AND POWER

A. If the Owner awards other contracts for collateral work on the Project, it shall be the obligation and responsibility of the General Contractor to provide and maintain temporary facilities for furnishing light and power necessary for operations under the General Contract, and to make all necessary arrangements therefor, including all required conductors, outlets and connections, ordering the meter, paying all fees and inspection charges and pay for all power bills until the date of the Certificate of Substantial Completion of the General Contract.

B. The facilities shall be available to other Contractors and their Subcontractors for their use in connection with their work. The installation and meters shall remain until need for same by each Contractor has ceased, or until the date of the Certificate of Substantial Completion of the General Contract. Each Contractor shall provide their own services after completion of the General Contract.

C. It shall be the responsibility of the General Contractor to provide, prior to the completion of their Contract, temporary power of proper voltage and capacity necessary to test and operate all equipment installed under this Contract.

00 15 10.05 PAYMENT FOR SERVICES DURING CONSTRUCTION

A. The General Contractor will receive no direct payment for providing, maintaining or removing any of the temporary facilities or services specified in this Section 00 15 10, and compensation for same shall be included, in the price, or total of prices, given in the Bid on which this Agreement is based, and no separate payment will be made therefor.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 15 68

EROSION AND SEDIMENT CONTROL

00 15 68.01 GENERAL

A. The Contractor shall control erosion and sediment caused by construction activities through the use of scheduling, phased construction and restoration, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains and other erosion control devices or methods.

B. In the event of conflict between these specification requirements and pollution control laws, rules or regulations of other Federal, State or local agencies, the more restrictive laws, rules or regulations shall apply.

00 15 68.02 CONTROL SCHEDULE

A. At the preconstruction conference, or prior to the start of the applicable construction, the Contractor shall be required to submit, for acceptance, their schedules for the accomplishment of erosion and sediment control. They shall also submit, for acceptance, their proposed method of erosion and sediment control on haul roads and borrow pits and their plan for disposal of waste materials or control details for other potential sources of pollution.

B. The Contractor shall schedule and conduct their operations to minimize erosion of soils and to prevent silting and muddying of streams, rivers, irrigation systems, impoundments (lakes, reservoirs, etc.) and lands adjacent to or affected by the work. Construction of drainage facilities and performance of other contract work which will contribute to the control of erosion and sedimentation shall be carried out prior to earthwork operations and maintained in conjunction with earthwork operations. The area of bare soil exposed at any one time by construction operations shall not exceed the maximum acreage allowable under applicable State and Federal laws.

00 15 68.03 CONTROL MEASURES

A. In carrying out erosion control measures, the Contractor will be guided by, but not limited to, the following controls:

1. When borrow material is obtained from other than commercially operated sources, erosion of the borrow site shall be so controlled both during and after completion of the work that erosion will be minimized and sediment will be prevented from entering streams or other bodies of water. Waste

or disposal areas and construction roads shall be located and constructed in a manner that will prevent sediment entering streams.

2. Frequent fording of live streams will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of stream crossings are necessary. Unless otherwise approved in writing by the Engineer, mechanized equipment shall not be operated in live streams.

3. When work areas or gravel pits are located in or adjacent to live streams or other bodies of water, such areas shall be separated from the main stream by a dike or other barrier to prevent entry of sediment into a flowing stream. Care shall be taken during the construction and removal of such barriers to prevent the muddying of a stream or body of water.

4. All waterways shall be cleared as soon as practicable of falsework, piling, debris or other obstructions placed during construction operations and not a part of the finished work.

5. Ditches which are filled, or partly inoperative shall be cleaned, stabilized, and made operative before the Contractor stops work for any day, and shall be maintained in a condition satisfactory to the Engineer for the duration of the Contract.

6. Water from aggregate washing, dewatering or other operations containing sediment shall be treated by filtration, settling basin or other means sufficient to reduce the turbidity so as not to cause a substantial visible contrast to natural conditions in the receiving waters.

7. Pollutants such as fuels, lubricants, bitumens, raw sewage and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or man-made channels leading thereto. Wash water or waste from concrete mixing operations shall not be allowed to enter live streams or other bodies of water.

8. All applicable regulations of environmental protection agencies, conservation agencies, and fish and wildlife agencies and statutes relating to the prevention and abatement of pollution shall be complied within the performance of the Contract.

9. Slopes exceeding 15 percent require special treatment such as water diversion berms, straw bale sediment barriers, sodding, fabric blankets or mesh, or the use of an approved mulch tacking agent over straw or hay mulch applied over seeded areas.

B. The erosion and sediment control features installed by the Contractor shall be acceptably maintained by the Contractor throughout the Contract period. When it becomes necessary, the Engineer will inform the Contractor of unsatisfactory construction procedures and operations insofar as erosion control, water and air pollution are concerned. If the unsatisfactory construction procedures and operations are not corrected promptly, the Engineer may suspend the performance of any or all of other construction until the unsatisfactory condition has been corrected.

00 15 68.04 PAYMENT

A. Unless a specific payment item is included in the Bid, payment for Erosion and Sediment Control shall be included in the price, or total of prices, given in the Bid on which this Agreement is based, and no separate payment will be made therefor.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 15 77

BASIC MAINTENANCE OF TRAFFIC

00 15 77.01 GENERAL

A. This work shall consist of basic maintenance and protection of traffic within the limits of and for the duration of the Contract.

00 15 77.02 TRAVEL NOT OBSTRUCTED DURING EXCAVATION

A. The Contractor shall not needlessly hinder or inconvenience travel on any public or private way, nor shall they wholly obstruct same without written permission of the Owner. If they are permitted to obstruct a traveled way, the Contractor shall provide plain and appropriately worded signs and adequate barricades and lighting at the nearest cross streets and at each end of the obstructed portion, announcing such obstruction and directing traffic to and along an approved detour.

B. Unless otherwise specified or permitted, all entrances and exits of fire houses, industrial plants, commercial buildings and public buildings shall be kept open and maintained in passable condition at all times. The Contractor shall give notice to the Owner of each traveled way before interfering therewith. A minimum of 24 hours notice shall also be given to local police and fire control agencies.

00 15 77.03 BASIC MAINTENANCE AND PROTECTION OF TRAFFIC

A. Traffic shall be maintained over a reasonably smooth traveled way which shall be so marked by signs, delineators, guiding devices and other methods that a person who has no knowledge of conditions may safely and with a minimum of discomfort and inconvenience ride, drive or walk, day or night, over all or any portion of the highway and/or structure under construction where traffic is to be maintained.

1. Surface. Maintain the surface condition of the traveled way so it is consistent with the appropriate speed limit.

2. Drainage. Maintain the drainage facilities and other highway elements, old or new, including detours.

3. Bus Stops. Maintain existing bus stops, if any, so bus passengers are reasonably accommodated.

4.	Pedestrian Traffic.	Provide adequate protection for pedestrian traffic during all phases of construction.
5.	Intersecting Highways.	Provide ingress and egress to and from intersecting highways, homes, businesses and commercial establishments.
6.	Dust Control and Spillage.	Control dust and keep the traveled way free from materials spilled from hauling equipment. This shall also apply to dust control and spilled material resulting from the Contractor's operations in the areas outside the Contract limits. The Contractor shall provide for the control of dust, as necessary, during the construction period. Dust shall be controlled by water spray, or as approved by Engineer. Exposed soils shall be graded, seeded and mulched as soon as practicable.
7.	Flaggers.	Provide the necessary traffic control equipment and flaggers for adequate traffic control on the traveled way.
8.	Repairs.	Make the necessary repairs to existing pavement and structure wearing surfaces as required to provide a reasonably smooth traveled way where vehicle operation is maintained.
9.	Responsibility to the Public.	Protect the public from damage to person and property which may result directly or indirectly from any construction operation.
10.	Snow and Ice Control.	Maintain the traveled way in such a condition and conduct operations in such a manner that snow and ice may be readily controlled by others as and when necessary, and in such a manner that proper drainage is provided for the melting of snow in the banks resulting from normal plowing. The Contractor shall not, however, be responsible for snow and ice control on the pavement or traveled way.

00 15 77.04 PAYMENT

A. Unless a specific payment item is included in the Bid, payment for Basic Maintenance of Traffic shall be included in the price, or total of prices, given in the Bid on which this Agreement is based, and no separate payment will be made therefor.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 15 80

PROJECT SIGN

00 15 80.01 GENERAL

A. If directed in the Additional Instructions, the Contractor shall provide and erect a project sign or signs at the project site identifying the project and the applicable funding agencies participating in the project. The project sign(s) shall also indicate the title and description of the project, Owner, Engineer and Contractor. The sign(s) shall be erected within twenty-one (21) days after the construction contract is awarded, and shall be in accordance with the specifications and detailed drawing included in the Additional Instructions.

00 15 80.02 SIGN PANEL

A. Each sign panel shall be constructed of 3/4" minimum thickness marine plywood rabbetted into a 2" x 4" lumber frame. All fasteners used in the construction of each sign shall be of a rustproof nature.

00 15 80.03 PAINTING

A. Each sign face shall be painted with the proper paint colors for the background, lettering and emblem as specified in the Additional Instructions. All supports, trim and the back of the sign panel, shall be painted with at least two coats of the same color paint as used for each sign face. All paint used shall be exterior grade paint, suitable for use on wood signs.

00 15 80.04 MISCELLANEOUS

A. Sign(s) shall be located in a prominent position and aligned as determined by the Engineer. Adequate support for the project sign(s) shall be provided by the Contractor. The bottom edge of each sign shall be a minimum of 3 feet above grade. The project sign(s) shall be maintained in good condition by the Contractor for the duration of construction. The removal of the project sign(s) from the construction site by the Contractor shall be at the completion of construction, when ordered by the Engineer.

00 15 80.05 PAYMENT

A. Unless a specific payment item is included in the Bid, payment for Project Sign, including fabrication, erection, maintenance and removal of each sign, shall be included in the price, or total prices, given in the Bid on which this Agreement is based, and no separate payment will be made therefor.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 15 90

ENGINEER'S FIELD OFFICE TRAILER

00 15 90.01 DESCRIPTION

A. Unless waived by provisions within the Additional Instructions, the Contractor shall provide a field office trailer for the exclusive use of the Engineer and their assistants. The trailer shall be separate from that of the Contractor, and shall be ready for occupancy within ten days following execution of the Contract.

00 15 90.02 FACILITIES TO BE PROVIDED

A. The name of the supplier and proposed layout shall be submitted to the Engineer and approved prior to delivery of the trailer.

B. The trailer office shall be new or in first class condition and shall be not less than 12 feet by 56 feet, excluding the tongue.

C. Washroom with hot water supply and toilet facilities within the trailer shall be supplied with potable water and connected to a sanitary sewage disposal system. The trailer shall be fully air conditioned. A gas or oil heat system shall be provided within the field office. A minimum of one month's fuel storage shall be provided, together with the necessary appurtenances to control heat and check fuel storage. Heating and air conditioning equipment shall be capable of maintaining an air temperature of 70^{o}F.

D. An individual, unlisted, direct line telephone service shall be provided for the exclusive use of the Engineer. Telephone service, local and toll charge calls, shall be paid by the Contractor.

E. It shall be the responsibility of the Contractor to maintain the field office trailer and all facilities furnished with it. Maintenance shall include removal of snow, janitorial services, and adequate protection of pipes.

F. It shall be the Contractor's responsibility to furnish adequate heat, electric power and light to the field office trailer at their expense. Adequate lighting shall consist of a minimum, of four, two lamp, 4' fluorescent lights.

G. The following office furniture and equipment shall be furnished with the trailer:

Two 8' flat top double desks with 2 sets of two drawer metal file cabinets in each desk.

1 built-in drafting table 36" x 72" with double storage cabinets underneath.

4 swivel chairs.

2 drafting stools.

1 four drawer, fireproof legal size filing cabinet with lock.

2 plan racks with space for 5 plan hangers each.

4 wall coat hooks.

2 large metal waste baskets.

1 refrigerator, minimum 2 cubic feet.

00 15 90.03 LOCATION

A. The trailer shall be erected on an approved location convenient for inspection of the work, as directed by the Engineer. The field office trailer shall be moved once if directed by the Engineer.

00 15 90.04 PAYMENT

A. Payment for the Engineer's Field Office Trailer, and all services to be provided with it, not included under other unit or lump sum price items shall be made at the price stated in the Bid.

END OF SECTION

GENERAL REQUIREMENTS

SECTION 00 16 40

MATERIALS, EQUIPMENT AND WORKMANSHIP

00 16 40.01 MATERIALS AND WORKMANSHIP - GENERAL REQUIREMENTS

A. All workmanship, materials, equipment and appliances shall comply in all respects with the applicable Specifications, unless specific exception is made.

B. All materials furnished or incorporated in the work shall be new, unused and of the quality and characteristics specified. Used materials may be furnished or incorporated in the work only under special circumstances and only with the Engineer's prior written approval. If the quality or characteristics of any material are not specifically set forth in the Contract Documents, the material used shall be that customarily used in first class work of a similar nature and character.

C. All workmanship in manufacture and construction not specifically covered in the Specifications shall be of the first class order and equal to that customarily used in first class work of a similar nature and character. The Contractor shall exercise special care during construction to make all structures watertight.

D. See also ARTICLE 00 07 54.02 and 00 07 53.08.

00 16 40.02 SAMPLES, TESTS AND INSPECTIONS

A. All materials, equipment and workmanship shall be subject to inspection, examination and tests by the Engineer, or persons or corporations designated by them, at any and all times during manufacture or construction and at any place or places where manufacture or construction are performed.

B. If required by the Specifications, or if requested by the Engineer, the Contractor shall submit to the Engineer for examination, testing and approval, typical samples of materials and appliances. Samples shall be submitted sufficiently in advance of the time they are proposed to be used in the work so that neither rejections and re-submittals nor the time reasonably required for testing shall cause delay. Each unit, lot or batch of materials submitted shall be properly tagged or labeled and identified with the portion of the work for which they are intended. Transmittals shall be covered by a letter of transmittal in the manner specified for the submittal of drawings ARTICLE 00 13 40.02.

C. All laboratory tests called for in the Specifications or requested by the Engineer shall be performed at the Contractor's expense. Documentary evidence that materials pass the required inspection and tests shall be furnished to the Engineer prior to the use of the materials in the work. Bureaus, laboratories and agencies

used for the inspection and testing of materials, equipment and appliances will be selected by the Contractor, who will submit their names to the Engineer for approval prior to the performance by them of any tests.

00 16 40.03 REMOVAL OF FINISHED WORK FOR INSPECTION

A. If, at any time prior to the date of the Certificate of Substantial Completion, the Engineer considers it necessary or advisable to examine any portion of the work already completed by removing or tearing out materials or coverings, or by excavating or otherwise exposing the portion of the work to be examined, the Contractor, upon receipt of a written request from the Engineer, shall promptly perform such work as is necessary so to do.

B. If the work in question is found to be defective, or not in conformance with the Specifications, due to the fault of or omission of the Contractor, or if any work shall be covered over without the consent or approval of the Engineer, whether or not defective, the Contractor shall bear all the expense of such removal, tearing out, excavating or exposing and of satisfactory reconstruction.

C. If, however, such consent or approval shall have been given, and the work exposed is found to be satisfactory and in conformance with the Specifications, the Contractor shall be compensated for the expenses of such removal, examination and reconstruction as provided in ARTICLE 00 07 57.03.

00 16 40.04 FIELD TESTS

A. The Contractor, at their own expense, shall conduct all tests specified or required by law or permit of installed equipment and materials, when ordered by and under the supervision of the Engineer. The Engineer at their own discretion may make additional field tests of materials and equipment on the Site. The Contractor shall furnish, at their own expense, the materials required for all field tests and reasonable labor and plant to assist the Engineer in conducting the tests.

00 16 40.05 MANUFACTURERS AND SUPPLIERS

A. Within 30 days following the execution of the Contract, the Contractor shall submit to the Engineer the name or names of the manufacturers or vendors from whom they propose to purchase the equipment and materials specified for the work. Following approval of the manufacturer or supplier by the Engineer, the Contractor shall submit complete and detailed drawings, bulletins, specifications and other data in connection with the equipment and materials and arrangement thereof they propose. See also ARTICLES 00 13 40.01 through 00 13 40.04 and 00 13 40.06.

B. No award shall be made by the Contractor, and no work in connection with the equipment or materials shall proceed prior to review of the submitted data. All

items of equipment of like type shall be the product of one manufacturer, unless specified otherwise or specifically permitted by the Engineer.

00 16 40.06 EXPERIENCE AND EQUIVALENT CLAUSES

A. Unless otherwise specified, shown or permitted, all equipment and materials shall be the product of manufacturers who have built equipment or produced materials of a like or similar type, character, size and capacity for at least three years prior to submittal for approval and who, if requested by the Engineer, shall submit evidence thereof.

B. Wherever reference is made in the Contract Documents to any specific material, equipment, appliance or model, it is understood that any product considered to be equivalent by the Engineer may be used, and such reference is for the purpose of illustration and establishment of a standard. This provision is understood to hold true in all instances, use or omission of the term "or equal" notwithstanding.

00 16 40.07 INSTALLATION OF EQUIPMENT

A. All equipment shall be installed in a neat and workmanlike manner as shown on the Plans or as directed, and shall be accurately leveled, aligned and adjusted for satisfactory operation and so installed that all necessary connections can be readily made.

B. The Contractor shall furnish, install and protect all necessary bearing plates, guides, rails, anchor and attachment bolts and fastenings and all other appliances and appurtenances required for the installation of all components of the equipment specified. Adequate templates and installation drawings and instructions shall be provided. Anchor bolts shall be of the size, type and material recommended by the manufacturer or directed by the Engineer.

C. The Contractor shall furnish all oils and greases for initial operation, and shall provide the Engineer with a list of the lubricants used on each item of equipment. Insofar as possible, all lubricants shall be obtained from one manufacturer, approved by the Engineer and by the equipment manufacturers. Each piece of equipment shall bear a substantial metal or plastic nameplate, securely fastened in a convenient place inscribed with the name of the manufacturer, the year of manufacture, model number, serial number and basic rating data.

00 16 40.08 TOOLS, ACCESSORIES AND MANUALS

A. Unless otherwise specified, the Contractor shall furnish for each type, model or size of equipment a complete set of any special tools and accessories, suitably identified, which may be required to adjust, operate, repair or maintain the equipment.

B. The Contractor shall also furnish and deliver to the Engineer five complete sets of bulletins, diagrams, parts lists, instructions, manuals and other data required for operation, maintenance and repair of the equipment.

00 16 40.09 CARE AND PROTECTION OF THE WORK

A. During the life of the Contract, the Contractor shall be solely responsible for the care and protection of the work and for all materials, appliances, supplies and equipment to be used in the work, both during storage and after installation or incorporation in the work. They shall protect all materials to be used in the work, all work in progress, and all completed work from damage by flood, fire, freezing or other undesirable results of weather, accident, theft and vandalism. Any damage or loss shall be made good by the Contractor at their own expense before a Certificate of Substantial Completion will be issued.

B. See also ARTICLES 00 07 59.07, 00 07 59.08 and 00 07 57.04.

00 16 40.10 ABSENCE OF ENGINEER

A. The Contractor shall perform no backfilling or covering operations of any underground portions of the work until after the Engineer or their inspector shall have inspected or tested and approved the work. If such work is covered in absence of an inspector, it shall be exposed by the Contractor for inspection as specified in ARTICLE 00 16 40.03.

END OF SECTION

SECTION 02 40 00

DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Demolition and Removal, as shown on the Plans, as specified and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American National Standards Institute, Inc. (ANSI) Publications:
      a. A10.4 - Safety Requirements for Personnel Hoists and Employee Elevators for Construction and Demolition Operations
      b. A10.6 - Demolition Operations – Safety Requirements
   2. National Fire Protection Association (NFPA) Publication:
      a. 241 - Safeguarding Construction, Alteration and Demolition Operations
   3. New York Code Rule and Regulations/Department of Labor:
      a. 12 NYCRR - Protection in Construction, Demolition and Part 23 Excavation Operations
   4. Occupational Safety and Health Administration (OSHA) Regulations:
      a. 29 CFR Part 1926 - Regulations for Construction

1.03 GENERAL REQUIREMENTS

A. Do not begin demolition until authorization is received from the Engineer. Remove rubbish and debris from the project site daily; do not allow accumulations inside or outside the building. Store materials that cannot be removed daily in areas specified by the Engineer. Demolish and remove materials containing asbestos in accordance with Section 02 82 33, "Removal and Disposal of Asbestos Materials".

1.04 SUBMITTALS: Submit the following:

A. Statements:
   1. Demolition plan

Submit proposed demolition and removal procedures to the Engineer for approval before work is started. Include procedures for coordination with other work in progress and, disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations.

1.05 REGULATORY AND SAFETY REQUIREMENTS

A. Comply with Federal, State, and local hauling and disposal regulations. In addition to the requirements of the "General Requirements", safety requirements shall conform with ANSI A10.4, ANSI A10.6, NFPA 241, 12 NYCRR Part 23 and OSHA 29 CFR Part 1926.

1.06 DUST AND DEBRIS CONTROL

A. Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily.

1.07 PROTECTION

A. Traffic Control Signs: Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Engineer prior to beginning such work.

B. Existing Work: Protect existing work which is to remain in place, be reused, or remain the property of the Owner. Repair items which are to remain which are to be salvaged and which are damaged during performance of the work to their original condition, or replace with new. Do not overload structural elements and pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Engineer approval.

C. Weather Protection: For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent displacement.

D. Facilities: Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.08 BURNING

A. Burning will not be permitted.

1.09 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by the Engineer.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 EXISTING FACILITIES TO BE REMOVED

A. Utilities and Related Equipment: Remove existing utilities, as indicated uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Engineer. Remove meters and related equipment and deliver to a location in accordance with instructions of the Engineer. If utility lines are encountered that are not shown on drawings, contact the Engineer for further instructions.

B. Paving and Slabs: Remove sawcut concrete and asphaltic concrete paving and slabs including aggregate base as required.

C. Roofing: Remove roofing to effect the connections with new flashing or roofing. Remove roofing and insulation without damaging the roof deck.

D. Masonry: Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as specified for the new work.

E. Concrete: Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

F. Patching: Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the

adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

1. Holes and depressions caused by previous physical damage or left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.
2. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.
3. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.02 FILLING

A. Fill holes and other hazardous openings as indicated.

3.03 DISPOSITION OF MATERIAL

A. Title to Materials: Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from Owner's property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Engineer of the Contractor's demolition and removal procedures, and authorization by the Engineer to begin demolition. The Owner will not be responsible for the condition or loss of, or damage to, such property after notice to proceed. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

B. Reuse of Materials and Equipment: Remove and store materials and equipment listed and indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.04 CLEANUP

A. Debris and Rubbish: Remove and transport debris and rubbish in a manner that will prevent spillage on pavements, streets or adjacent areas. Limit to 3/8-cubic yard capacity buggies or other conveyances used on roofs and within the building to transport removed debris. Clean up spillage from pavements, streets and adjacent areas.

END OF SECTION

SECTION 03 21 00

REINFORCING STEEL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for installing all Reinforcing Steel, welded wire fabric and accessories for cast-in-place concrete as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. Reference to standard specifications for the following organizations is intended to specify minimum standards for quality of materials and performance of workmanship, and for standard test methods.
   1. American Society for Testing and Materials (ASTM) Publications, Latest Edition
   2. American Concrete Institute (ACI) Standards, Latest Edition
   3. American Welding Society (AWS) Publications, Latest Edition
   4. American National Standards Institute (ANSI) Publications, Latest Edition
   5. Concrete Reinforcing Steel Institute (CRSI) Publications, Latest Edition

1.03 SUBMITTALS

A. Shop Drawings: Indicate bar sizes, spacings, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices. No work on fabricating or placing steel shall be done until such drawings and schedules have been approved.

B. Manufacturer's Certificate: Submit certified copies of mill test report of reinforcement materials analysis.

C. Welder's Certificate: Submit certification from welders employed on the work, verifying AWS qualification within the previous twelve months.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforcing steel bars shall be free from defects, kinks, bends, rust, scale or other irregularities. Reinforcing mesh shall be of the electrically welded type, with wires arranged in rectangular or square patterns.

B. Reinforcing bars shall be deformed billet steel meeting the requirements of ASTM A615 Grade 60.

C. Steel wire fabric shall meet the requirements of ASTM A185.

D. Stirrup steel shall be cold drawn steel wire meeting the requirements of ASTM A82.

E. Epoxy coated reinforcing bars shall be deformed billet steel meeting the requirements of ASTM A775, Grade 60.

F. Galvanized reinforcing bars shall be deformed billet steel meeting the requirements of ASTM A767, Grade 60.

G. Accessory materials shall include: tie wire, minimum 16 gage annealed type. Epoxy-coated reinforcing bars shall be tied with plastic-; epoxy-; or nylon-coated tie wire. Chairs, bolsters, bar supports, and spacers shall be sized and shaped for strength and support of reinforcement during concrete placement conditions.

2.02 IDENTIFICATION AND PROTECTION OF BARS AND FABRIC

A. Reinforcing steel shall be delivered to the work in strongly tied bundles identified with metal tags corresponding to the bar schedules and diagrams. Identification marks shall show quantity, producing mill, bar size, type of steel and grade mark.

B. All bars and fabric shall be stored off the ground and shall, at all times, be protected from moisture and be kept free from dirt, oil, or injurious coatings. Epoxy-coated reinforcing bars shall be stored on protective cribbing. If concreting is delayed for any considerable number of days after the reinforcing is placed in position, it shall be protected by covering with canvas or other satisfactory covering, or, if directed, shall be painted with a coat of neat cement grout.

C. Any bar or fabric having a scaly rust shall be cleaned. Epoxy-coated reinforcing bars that are cut, welded or otherwise damaged shall be repaired with patching material conforming to ASTM A775 and done in accordance with the Material Manufacturer's recommendation. Galvanized reinforcing bars that are cut, welded or otherwise damaged shall be repaired with patching material conforming to ASTM A767 and done in accordance with the Material Manufacturer's recommendation. The Contractor will be required to replace bars exhibiting severely damaged coatings.

PART 3 - EXECUTION

3.01 FABRICATION AND INSTALLATION

A. Metal reinforcing shall be properly fabricated in accordance to references specified.

B. Metal reinforcing shall be properly placed in accordance to CRSI, ACI 301, ACI 318, ACI SP-66, as shown on the approved Shop Drawings and as herein directed.

C. Bars shall be bent in the shop to the shapes shown or required. Field bending shall be done only with the written approval of the Engineer. Field welding shall not be allowed without direct approval and supervision of the Engineer.

D. Unless otherwise shown, splices in tension reinforcement shall not be permitted, and splices in compression reinforcement shall be lapped 40 diameters. All bar splices shall be staggered, wherever possible. Locate splices not indicated on drawings, at point of minimum stress. Splice locations must be approved by the Engineer.

E. Reinforcing shall be securely tied and supported and must not be displaced during concrete placing operations. Epoxy-coated reinforcing bars shall rest on coated wire bar supports, or other acceptable materials. Dowels must be wired in place before concreting begins. All metal shall be kept away from exposed surfaces of concrete.

F. Conduit in slabs on grade shall be placed in a depression below the slab and the mesh run continuous over conduit. Conduit in slabs on forms shall be above the bottom reinforcing and below the top reinforcing. No conduit is permitted in thin joist slabs.

G. Cutting of bars to clear openings in walls or slabs is strictly prohibited. Warp bars around such openings.

H. Provide two #6 diagonal bars at each corner of every rectangular opening in walls, unless otherwise shown on the Plans.

I. All slabs, unless otherwise shown on the Plans, to be reinforced with not less than WWF 6 x 6 - W2.9 x W2.9 welded wire mesh.

J. Placing of concrete shall not be scheduled until all of the reinforcing for the section is secured in place and the reinforcing and forms have been approved by the Engineer or his representative. Contractor shall notify the Engineer 24 hours prior to a concrete pour.

K. Welded wire mesh in slabs is to be placed in the upper third of the depth of the slab. Lap 6" minimum. Fabric shall be straightened as required before placement.

L. Provide bent bars 6'-0" long of same size and spacing as horizontal bars for all corners of foundation walls, unless otherwise shown on the Plans.

M. Do not displace or damage vapor barrier.

N. For footing reinforcement - support bars on small precast concrete blocks; space at intervals as shown on the Plans and within minimum height specified above underside of slab or footing.

O. Reinforcement shall not be bent after being partially embedded in hardened concrete.

3.02 CONCRETE PROTECTION FOR REINFORCEMENT

A. Unless otherwise shown or directed, concrete protection, measured from the surface of the bar, shall be the following:

1. For concrete deposited against the ground, without the use of forms ..... 3 inches
2. For formed concrete in contact with the ground ..... 2 inches
3. For slabs and walls contacting water or sewage ..... 2 inches
   For beams, girders and columns not directly exposed to ground and weather ..... 1-1/2 inches
4. For formed concrete exposed to the weather ..... 2 inches
5. For slabs and walls, not directly exposed to ground, weather, water or sewage ..... 1 inch

B. Exposed reinforcing bars intended for bonding with future extensions shall be protected from corrosion by a covering of concrete or other approved material.

3.03 FIELD QUALITY CONTROL

A. Field inspection will be performed under the provisions of Section 03 30 00 or 03 30 20.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for plain and reinforced Cast-In-Place Concrete work including accessory items of work herein described, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. Reference to standard specifications for the following organizations is intended to specify minimum standards for quality of materials and performance of workmanship, and for standard test methods.
   1. American Society for Testing and Materials (ASTM) Publications, Latest Edition.
   2. American Concrete Institute (ACI) Standards, Latest Edition.
   3. Standard Specifications - Construction and Materials, New York State Department of Transportation (NYSDOT), Latest Edition, including Addenda thereto.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301 and ACI 302.

B. Acquire cement and aggregate from same source for all work.

C. Conform to ACI 305R when concreting during hot weather, except as herein modified.

D. Conform to ACI 306R when concreting during cold weather, except as herein modified.

1.04 SUBMITTALS, SAMPLES AND TESTS

A. Product Data: Provide data on joint devices, attachment accessories and admixtures.

B. Concrete:
   1. Samples and tests of all materials to be incorporated in the concrete shall be submitted in ample time for testing before delivery. All materials are subject to inspection and testing by a commercial testing laboratory approved by the Engineer at the Owner’s expense. All materials are subject to approval by the Engineer prior to their delivery to the site.

2. The Contractor shall obtain from the manufacturer, prior to the actual delivery of the concrete, a statement giving the sources, specific gravities, and sieve analyses of the aggregates and the dry weights of cement and saturated-surface-dry weights of fine and coarse aggregate and quantities, type and name of admixture (if any) and of water per cubic yard of concrete that will be used in the manufacture of each class of concrete to be provided. This data shall be sent to the Engineer for review and approval.
   a. Aggregates shall be tested for gradation, purity and accelerated soundness. Tests shall comply with ASTM C33, C136, ASTM C40, and ASTM C88. The source of the material shall not be changed without retesting.
   b. Cement shall have representative mill test reports on physical and chemical requirements. All cement stored at job site or at concrete supplier's place for over 60 days shall be tested for compliance with ASTM C150.
   c. Contractor shall submit concrete mix design to be reviewed by the Engineer.
   d. Tests of other materials may be required by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials shown, specified or required to be incorporated in cast-in-place concrete shall be of finest quality, and shall be delivered, stored and handled so as to prevent damage. Damaged or inferior materials will be rejected. Approved brands or sources must be used, without change for the entire project. All materials shall be proportioned to produce a well graded mixture of high density and maximum workability.

B. Portland Cement shall be a standard brand in compliance with ASTM C150 Type I. Only one brand shall be used for exposed work. Generally, Type I cement shall be used; however, Types II or III may be employed with the approval of the Engineer or if shown, or specified.

C. Fine Aggregates shall be clean, sharp, natural sand, free from loam, clay, organic impurities or frozen materials and shall conform to ASTM C33 in all respects. Sand shall be tested for impurities in accordance with ASTM C40.

D. Coarse Aggregates shall consist of strong, clean, crushed limestone or crushed gravel, free from harmful material and meeting all of the requirements of ASTM C33. Coarse aggregate shall also comply with New York State Department of Transportation Material Designation 703-02. Crushed limestone and crushed gravel shall meet the Physical Requirements (Testing) Designation 703-0201 and 703-0202, respectively.

E. Water used in mixing concrete shall be clean and free from all acid, alkali or organic matter and shall be obtained from a public water supply unless specifically permitted otherwise by the Engineer.

F. Ready Mix Concrete shall comply with ASTM Specification C94, this Specification, and used subject to the Engineer's approval.

G. Admixtures, where shown or specified, shall be as follows:
1. Air entraining agent shall be "Daravair" or "Darex AEA" as manufactured by W.R. Grace Co., or Master Builder's "MBVR", or equal meeting the requirements of ASTM C260.
2. Water reducing agent shall be Sika "Plastiment", Master Builder's "Pozzolith", W.R. Grace's "WRDA", or equal meeting the requirements of ASTM C494.
3. High range water reducers or superplasticizers shall be Sika "Sikament-FF", W.R. Grace's "Daracem-100" or "WRDA-19", or equal meeting the requirements of ASTM C494.

H. Bonding Agent, where shown or specified, shall be "Dural 104" bonding compound manufactured by Dural International Corporation, "Sikadur 32 Hi Mod" by Sika Corporation, or equal.

I. Anchorage Items, where shown or specified, shall be as follows:
1. Inserts for fastening shelf angles shall be malleable iron adjustable wedge type, with bolt and washer, if required, as manufactured by Hohman & Barnard, Inc., Richmond Screw Anchor Co., Inc., or equal.
2. Threaded inserts for fastening of soffits of concrete beams shall malleable iron, as manufactured by Hohman & Barnard, Inc., Richmond Screw Anchor Co., Inc., or equal.
3. Ceiling hanger inserts shall be standard type wire as manufactured by Hohman & Barnard, Inc., Heckman Building Products, Inc., or equal.
4. Masonry anchor slots shall be galvanized sheet metal, felt filled, as manufactured by Hohman & Barnard, Inc., Heckman Building Products, Inc., or equal.
5. Flashing reglets shall be O'Keefe's Inc., PVC "Watertite Type P", or equal to size and shape shown.

J. Flexible Sleeve, where shown or specified, shall be of resilient rubber with a flanged, serrated waterstop and shall be cast directly into the walls of the concrete structure as shown on the Contract Documents. Flexible sleeve shall conform to the following physical requirements:

PROPERTY	ASTM TEST REQUIREMENTS		
	METHOD	MIN.	MAX.
Tensile Strength, psi	D412	1500	-
Ultimate Elongation, percent	D412	450	-
Hardness, Type A durometer	D2240	45	55

1. Flexible sleeve must permit a minimum of 10 degrees deflection in all directions. Flexible sleeve shall be "Lockjoint Flexible Manhole Sleeve" as manufactured by Chardon Rubber Company, or equal.

K. Forms shall be wood, metal, or other approved materials as follows:
1. Plywood shall be Commercial Standard Douglas Fir, moisture resistant, concrete form plywood, at least 5-ply 5/8" thick.
2. Metal forms shall be as approved, and must produce surfaces equal to those specified for wood forms.
3. Form oil shall be an approved non-staining mineral oil, such as "Duogaurd II" by W.R. Meadows, or equal.
4. Form ties shall be of approved design, adjustable length and free of devices that will leave hole or depression larger than 7/8" diameter. When forms are removed no metal shall be left within 1" of finished surface.

L. Waterstops, where shown or specified, shall be minimum 3/8-inch thick across their entire section, heavy duty, serrated type manufactured from virgin polyvinyl chloride compound, "Model RB6-38H" as manufactured by Vinylex Corporation, or equal. They shall have a tensile strength of minimum 1800 psi and an elongation of minimum 200%.
1. Waterstops shall be open bulb type, 6-inch wide unless otherwise shown or directed by the Engineer. The waterstops shall be supported during concrete placement to prevent dislodgement and to insure that the ends remain at right angles to the joint. Field joints shall be butt welded with an electric iron in accordance with the manufacturer's instructions.
2. Sample of the waterstops to be used shall be submitted to the Engineer for approval.

M. Premolded Joint Filler, where shown or specified, shall be premolded, resilient, non-extruding type, 1/2-inch thick unless shown otherwise, full depth of concrete section as manufactured by Celotex Corporation, "Fibre Expansion Joint Filler" by W.R. Meadows, or equal.
1. Sample of the premolded filler proposed to be used shall be submitted to the Engineer for approval.

N. Joint Sealant, where shown or specified, shall be elastomeric polyurethane sealant material, black in unexposed locations, and grey in exposed locations, and have balanced properties of elongation recovery and tensile strength, and shall be Sonneborn "Sonolastic NP1", Sika "Sikaflex 1A", or equal.

O. Protective Covering for concrete finish slabs, where shown or specified, shall be "Orange Label Sisalkraft", Polyethylene Film as manufactured by Fortifiber Corp., or equal.

P. Non-Shrink Grout, where shown or specified, shall be premixed compound consisting of non-metallic aggregate, natural aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days; such as "Masterflow" as manufactured by Master Builders, "SikaGrout 212" as manufactured by Sika, or approved equal.

1. Non-Shrink grout shall be used under structural steel column baseplates and all equipment baseplates. All work shall be done in strict accordance with the manufacturer's recommendations. At the request of the Engineer, the manufacturer's representative shall be called to the job site for consultation regarding detailed use of the grout.

Q. Grout for fillets, channels, or other non-structural applications shall consist of one (1) part cement (Portland Cement Type 2) and three (3) parts fine aggregate (sand) with sufficient mixing water for the intended application.

R. Cementitious Coating Materials, where shown or specified, shall be "Thoroseal" with "Acryle 60" bonding agent, as manufactured by Thoro System Products, "Anchor Masonry Surfacer" as manufactured by Anti Hydro Waterproofing Company, or equal.

S. Curing Compound shall be acrylic based "Kure-N-Seal" as manufactured by Sonneborn, acrylic based "CS-309", or water based "VOCOMP-20" as manufactured by W.R. Meadows, or equal.

T. Vapor Retarder, where shown or specified, shall be "Moistop" as manufactured by Fortifiber Corp. Vapor Barrier shall be "Premoulded Membrane Vaporseal" as manufactured by W.R. Meadows, or equal.

U. Perimeter Insulation, where shown or specified, shall be "Styrofoam Square Edge" as manufactured by the Dow Chemical Corporation, "Foamular 250" as manufactured by UC Industries, or equal.

V. Penetrating Sealer, where shown or specified, shall be two components, 50% solids penetrating epoxy sealer. The penetrating sealer shall be fully compatible with the types of form oil, curing compound and joint sealant used.

1. Concrete surfaces to be treated must be dry, cured for a minimum of 21 days, free from surface accumulations of dust, dirt, oil, debris, concrete curing compounds, bond breakers, or other compounds which would prevent penetration and intimate contact between the concrete surface and the penetrating sealer. Concrete surfaces require preparation per manufacturer's directions prior to sealer installation.
2. Penetrating sealer shall be "Spec-Seal" as manufactured by Conspec, Inc., or equal.

W. Metal Slab Joints, where shown or specified, shall be keyed type, minimum 18 gauge, galvanized steel by Heckmann Building Products, or equal.

X. Vapor Barrier: 10 mil 0.254 mm) thick clear polyethylene film type recommended for below grade application.

2.02 CONCRETE MIX DESIGN

A. The Contractor shall submit concrete mix designs to be reviewed by the Engineer. The mix designs shall be confirmed by making and testing trial mixes for each class of concrete to be incorporated in the work. All testing shall be made by an approved testing laboratory at the expense of the Contractor. Mix designs shall conform to the ACI 301, except as may be modified in the Plans and/or Specifications.

B. No job concrete shall be poured until the mix design for that concrete has been approved by the Engineer. Once the mix has been approved, it shall not be changed, except when requested by the Engineer, or if requested by the Contractor and approved by the Engineer.

C. Ready-mixed concrete from an established company will be approved, if conforming to ASTM C94, and to this specification. All concrete shall be batched, mixed, delivered to the site, and shall conform to these requirements and be controlled in a manner to assure uniform concrete for the quality specified.

D. Water/cement ratios of all mixes shall be determined from w/c curve plotted from tests of the cement and aggregates used on the job. If necessary to increase the water content of the mix due to field conditions, sufficient cement must be added to maintain the design water/cement ratio. Accelerating or retarding admixtures may be permitted by the Engineer if requested by the Contractor to compensate for adverse weather conditions.
1. The various classes of concrete shall be designated as follows:

MAXIMUM PERMISSIBLE WATER-CEMENT RATIOS FOR CONCRETE (WHEN STRENGTH DATA FROM TRIAL BATCHES OR FIELD EXPERIENCE ARE NOT AVAILABLE) Maximum permissible water-cement ratio					
CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH IN PSI*	NON-AIR-ENTRAINED CONCRETE		AIR-ENTRAINED CONCRETE	
		ABSOLUTE RATIO BY WEIGHT	US GAL. PER 94-LB. BAG OF CEMENT	ABSOLUTE RATIO BY WEIGHT	US GAL. PER 94-LB. BAG OF CEMENT
A	5,000	**	**	**	**
B	4,000	0.44	5.0	0.35	4.0
C	3,000	0.58	6.6	0.46	5.2
D	2,500	0.67	7.6	0.54	6.1
E	2,000	0.71	8.0	-	-

*28-day strength. With most materials, water/cement ratios shown will provide average strengths greater than indicated in Section 5.4 of ACI 318R as being required.
**For strength above 4,500 psi (non-air-entrained concrete) and 4,000 psi (air-entrained concrete) proportions shall be established by methods of Section 5.3 of ACI 318R.

Unless otherwise specified, all concrete shall be Class "B", non-air-entrained except exposed concrete which shall be air-entrained. When foundation walls or grade beams are exposed to weather above grade, the entire wall shall be considered exposed concrete.

2. Maximum size aggregates shall be used as follows unless otherwise designated by the Engineer.

1-1/2"	general work
3/4"	thin sections; heavy reinforcing
3/4"	columns, beams and slabs
Over 1-1/2"	massive structures, with approval
3/8"	floor toppings

3. Slump - Maximum:

Reinforced concrete – general	4"
Reinforced concrete - thin walls, columns	5"
Non-reinforced concrete	3"
Pavements, including sidewalks	3"
Heavy mass concrete	3"

4. Air Content: Use an approved air entraining admixture. The entrained content shall be controlled between 4% - 6%. See Plans for concrete work requiring air entrainment.
   a. For mixes containing coarse aggregate with a top size of 3/4" or smaller and for exposed concrete subject to frost and salt action, air contents shall be increased to the range of 5% - 7%.

5. Should the Contractor feel it advantageous to employ concrete additives to improve workmanship or facilitate his work, he shall obtain the approval of the Engineer prior to his use of additives.
6. Use of accelerating admixtures in cold weather will not relax cold weather placement requirements.

2.03 STORAGE OF MATERIALS

A. Portland cement shall be stored in a weather-tight structure. No cement that has taken a warehouse set shall be used and any stored over sixty (60) days shall be rejected unless tested for soundness and setting time under ASTM C150. Such tests shall be at the Contractor's expense.

B. Fine and coarse aggregates shall be kept separated and free from deleterious substances. All topsoil shall be removed from the storage area. Materials shall be stockpiled in layers to prevent segregation; however, re-mixing may be required if gradation is not maintained. Care shall be taken not to inter-mix materials in the area with the aggregates.

C. Any materials that have deteriorated or become contaminated will be rejected for use in the concrete and must be promptly disposed of by the Contractor.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Before each pour, forms and reinforcing shall be inspected and approved by the Engineer. The Contractor shall give at least 24 hours' notice before such an inspection is required. No pour shall be started until the Engineer has given approval. No concreting may be done in the absence of the Engineer without written permission of the Engineer.

B. Concrete Batch Ticket:
1. The Contractor shall require the manufacturer of the concrete to furnish to the Engineer with each batch of concrete before unloading at the site, a delivery ticket on which is printed, stamped, or written, information concerning said concrete as follows:
- Name of ready-mix batch plant
- Serial number of ticket
- Date
- Truck number
- Name of purchaser
- Specific designation of job (name and location)
- Designation of the concrete by compressive strength
- Amount of concrete in cubic yards
- Time loaded or of first mixing of cement and aggregates
- Reading of revolution counter at the first addition of water

- Type and brand, and amount of cement
- Type and brand, and amount of admixtures
- Total water added by producer (and W/C ratio)
- Water added at job site (upon approval of the Engineer)
- Maximum size of aggregate
- Weights of fine and coarse aggregate
- Ingredients certified as being previously approved
- Signature or initials of ready-mix representative

C. Concrete Testing:

1. The Owner shall employ an approved commercial testing laboratory at its own expense to provide field sampling, testing and inspection of all concrete. Continuous inspection by the approved testing laboratory shall be provided during all concrete pours. The Contractor shall maintain a record set of plans at the site showing date and amount of each pour, test results and temperature. If any portion of the work shows low test results, the Engineer may require batch plant inspection, additional testing, load tests, cored samples, and/or replacement of the faulty work, etc., at the Contractor's expense.
2. The Owner, through its approved testing laboratory, shall make all laboratory or field tests as required and shall furnish all necessary equipment. The Owner, through its approved testing laboratory, shall transport all test cylinders from the site to the laboratory.
3. Field concrete inspection: The Owner, through its approved testing laboratory, shall provide a competent field concrete inspector whose minimum duties shall be as follows:
   a. Check each truck on arrival to make sure that the concrete is not retempered.
   b. Make necessary slump tests for uniformity control.
   c. Make air tests and yield tests as required.
   d. Make any and all test cylinders as may be required in the Specifications.
   e. Notify the Engineers and/or his representative if any test results vary from the specified limits.
4. Tests:
   a. Concrete shall be tested by an approved testing laboratory as follows:
      - Standard 6" x 12" compression cylinders shall be in compliance with ASTM C39 in sets of four and shall be moist cured. Break 2 at 7 days, and 2 at 28 days. One set shall be made for approval of each mix design, one set for first pour of 50 cubic yards or less, and one set for each additional pour of 50 cubic yards. If less than 50 cubic yards are placed in one day, one set shall be made for each day's pour.

- All test cylinders shall be cast, moist cured and broken under laboratory conditions in accordance with the ASTM C31 and ASTM C39. All four cylinders of a test shall be taken from the middle third of a single load. Each cylinder shall be properly labeled with an identifying mark, the mix proportions, air content, amount of water, slump, and the location in the structure where the concrete was placed. Test reports shall include all this information. Distribute copies of reports as requested by the Engineer. Should any results be questionable, the Engineer shall be notified immediately so that corrective measures can be taken. Any test cylinder which has broken and fails to meet requirements shall be preserved for inspection by the Engineer.

D. Records:
   1. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.02 BATCHING AND MIXING

A. All Batching and Mixing shall conform to the following and the ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".

B. Aggregates and bulk cement shall be measured to within 1% by weight. Cement in standard sacks need not be weighed. Water shall be measured by volume or by weight to within 1/2%. Aggregate weights shall be corrected for moisture content. Admixtures shall be added through appropriate dispensing equipment to an accuracy of 3%.

C. The complete plant assembly shall be approved by the Engineer and shall conform to the following requirements:
   1. Provide ready adjustment of aggregate weights for varying moisture contents.
   2. Provide means of accurately controlling and easily checking water-cement ratio.
   3. Provide accurate control of all materials with positive shut-off.
   4. Facilities shall be provided for prompt removal of excess materials in hoppers.
   5. Each specified size of aggregate shall be measured separately with a separate beam scale.
   6. Bulk cement shall be dropped through canvas drop chutes or telescopic flexible hose tremie.

D. Concrete mixers or mixer trucks shall not be loaded to more than the rated capacity of the truck.

E. All concrete shall be mixed not less than 60 revolutions in the drum of a modern power mixer, at the rated speed of rotation. Mix not less than an additional 30 revolutions after the addition of any further water to the mix.

F. Do not add raw materials to the drum until all of the preceding batch has been discharged. For transit mixers, the wash water shall be discharged and not used as part of the mix water for the next batch.

G. Transit-mixed concrete shall be transported to the job site unmixed and only after arrival at the job site shall mixing begin. All concrete shall be unloaded from the mixer within 45 minutes after completion of mixing. All concrete still remaining in the truck shall be rejected.

H. The total time interval from the time the cement makes contact with the aggregate to the complete unloading from the mixer shall not exceed 90 minutes, unless such time is extended by the Engineer. The time may be reduced in hot weather or under unusual conditions, if unsatisfactory results are obtained.

3.03 FORMWORK

A. The Contractor shall design and construct suitable and adequate formwork in conformance with ACI 347R. All shoring shall be properly braced to safely withstand all vertical, moving and lateral forces during the construction period. Responsibility for adequacy and safety rests with the Contractor. Materials shall be as stated in Paragraph 2.1.

B. General requirements for all forms shall be as follows:
   1. Forms shall be constructed of wood, plywood, or steel.
      a. All forms shall be set true to line, plumb, and properly braced so as to maintain the desired position and shape during and after pouring concrete. Forms shall be sufficiently tight to prevent leakage.
      b. All joints between sheets shall be backed up to assure that both sheets are in the same plane. Edges of abutting sheets shall be straight and true and shall be forced tightly together to minimize fins. Quality of form contact surfaces shall be subject to Engineer's approval.
      c. Form ties shall be designed for the specific wall thickness required, and after removal of the external portion, no metal shall remain closer than one inch (1") from the surface. Ties to be left in place shall be equipped with washers or other approved devices to prevent seepage of moisture along the tie. The removable portion shall be oil or grease coated.

d. Immediately following the removal of forms, the projecting ties shall be removed and all holes filled with grout flush with the wall. Care shall be taken to use the same brand of cement and same mix proportions used in the wall to prevent color differences.

e. Forms for walls and columns shall be provided with removable cleanout panels, to allow removal of chips and debris. All plywood forms must be new when first used on this job, but may be reused if kept in good condition. All forms shall be swept or flushed clean of shavings, debris, and other loose material. Loose earth and rock shall be scraped from footing trenches before pouring concrete.

f. Provide 3/4" chamfer strips, unless noted otherwise on the drawings, at all exposed corners of columns, beams and walls where later finish is not to be applied.

g. All forms and shores for floor and roof slabs and beams shall be "crowned" or "cambered" 1/4" for each 12 feet of span to eliminate dead load deflection. All forms shall be oiled with a non-staining mineral form oil before placing reinforcing.

h. Build into forms all hangers, anchors, bolts, inserts, sleeves, etc., required to be set as part of this work, place and secure in exact position.

C. Form removal shall be as follows:

1. It shall be the Contractor's responsibility to determine the time at which forms may be removed without endangering the structure, subject to the following limitations, unless documentation is provided to modify these requirements:

Footing forms - 24 hours minimum; continue curing as specified.

Wall forms - 2 days minimum for ten (10) feet high. Add one (1) day for each additional five (5) feet of height; continue curing as specified.

Superstructure slabs, beams and columns shall not be stripped until the concrete attains at least 75% of its design strength as proven by test cylinders, and until a minimum of 14 days has elapsed.

Reshoring - immediately after stripping, fully reshore all slabs which are to be used to support shores for upper slabs. All forms for upper floor pours must be supported by shoring to at least two levels of full strength concrete.

3.04 JOINTS FOR CONCRETE

A. Joints for concrete shall include all expansion joints, construction joints and contraction joints.

B. All joints shall be constructed at locations shown on the drawings, or as directed by the Engineer. Additional joints may be constructed by the Contractor subject to the approval of the Engineer.

C. Expansion Joints:
1. Expansion joints shall be constructed where shown and as directed. Reinforcement, corner protection angles or other fixed items embedded or bonded into concrete shall not be run continuously through expansion joints. Reinforcement shall be discontinued 2 inches from the joint face. A slightly rounded edging shall be provided to finish neatly all edges around expansion joints.
2. Preformed expansion joint filler material, sealant and waterstops, where shown on the drawings, shall be as specified in Paragraph 2.1.

D. Construction Joints:
1. The location of construction joints shall be chosen by the Contractor and shall be subject to the Engineer's approval except where specifically located on the Plans.
2. Horizontal construction joints in walls will not be permitted, except with the approval of the Engineer. In order to minimize shrinkage, long continuous walls shall not be poured at one time. No more than 50 feet in horizontal direction shall be poured without a construction joint, unless prior approval is obtained from the Engineer.
3. Reinforcing shall be discontinuous through a construction joint, unless otherwise noted on drawings. As shown or specified on the drawings, additional No. 3 reinforcing bars spaced at 12-inches on center shall be placed horizontally in each construction joint at the center of the section. These bars shall be 4-feet long and shall extend 2-feet on each side of the joint. Reinforcement projecting through joint shall be kept clean.
4. As indicated on the drawings, all construction joints shall be provided with a keyway and a PVC waterstop as specified in Paragraph 2.1. The joint surface of the concrete previously placed shall be cleaned of all foreign matter and laitance by means of sandblasting with steam and sharp sand, or by other approved methods, until coarse aggregate is exposed. The concrete surface shall be saturated for a period of 6 hours and excess water then removed.
5. The new concrete shall be preceded by about 1/2-inch of soft mortar of the same proportions as that in the concrete. When accessible, this shall be scrubbed into the surface of the joint with wire brooms. When waterproofing is required, the entire joint shall be parged with a grout of approved mixture as recommended by the manufacturer of the waterproofing admixture, or one composed of one part integral

waterproofing, three parts water and sufficient Portland Cement to form a thick, creamy mixture. This grout shall be fresh when followed by the new concrete. In column forms and deep narrow forms, the concrete placement shall be started with an oversanded mix with 5/8-inch maximum aggregate, and extra sack of cement per cubic yard, and a 5-inch slump. This mix shall be placed maximum 2 inches deep on the construction joint. A mortar layer shall not be used.

6. As indicated on drawings, a metal keyed floor slab joint may be used in lieu of above method.

E. Contraction (Control) Joints:

1. Contraction joints shall be located as shown on the drawings or as directed. Reinforcement through the joint shall be continuous as shown on the drawings and/or as directed by the Engineer.
2. Sawcut contraction joints (Type "A") shall be made by cutting the concrete surface and filling with the sealant material as specified under paragraph 2.1. Cutting shall be done after the surface is firm enough not to be damaged by the cutting blade. Time of cutting shall be approved by the Engineer.
3. Formed contraction joints (Type "B") shall be made by tooling with a 1/4-inch radius edging tool and filled with the sealant material as specified under paragraph 2.1.
4. Premolded Contraction Joints (Type “C”) shall be "Kold-Seal Zipper Strip" by Vinylex or "Zip Cap Control Joint" by Greenstreak Products, or equal.
5. As indicated on drawings, a metal keyed floor slab joint may be used in lieu of above method.

3.05 INSERTS AND SLEEVES

A. The Contractor shall cooperate with all other Contractors in permitting the placing of all necessary sleeves, conduit, or inserts for hangers for their trades. The Contractor shall notify the trades of all pours in ample time for the responsible Contractor to place all embedded items, sleeves, slots, holes or chases.

B. Accurately set all slots, chases, anchor bolts, opening, etc. All inserts for hanging mechanical equipment shall be provided and set by the Contractor for the trade involved. All sleeves for piping passing through floors and walls shall be provided by the Contractor for the trade involved and set by the General Contractor.

C. All conduit which must be placed in concrete slabs shall be installed after, and above the bottom reinforcing, but before, and under the top reinforcing. Where conduit cross-overs are necessary, they shall be located so that reinforcing is not displaced from its specified position.

D. All anchor bolts for the structural steel shall be carefully set as shown on the fabricator's approved anchor bolt plan.

E. If, in the judgement of the Engineer, embedded items are located or grouped in a manner that will weaken the structure, the Contractor shall take the necessary corrective steps.

F. All inserts and sleeves where the outside diameter is greater than the spacing between the reinforcing steel, the reinforcing bars shall be warped around such inserts and sleeves. Unless shown otherwise on the drawings, provide, as a minimum, two #4 diagonal bars per face at 90 degrees to each other all around the inserts and sleeves.

G. Where openings are left in new concrete or are made in existing concrete for the insertion of wall castings, pipes or other fixtures, the space around these fixtures shall be made watertight by completely filling with a non-shrinking concrete containing an admixture of "SikaSet-C", "Anti-Hydro" Concrete Waterproofing Agent, or equal.

3.06 CONVEYING AND PLACING CONCRETE

A. The placing or depositing of all concrete shall be done in accordance with ACI 304, and as modified herein.

B. Preparation Prior to Placing Concrete:
   1. Prepare previously placed concrete surfaces by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
   2. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
   3. Before placing concrete, all debris, water, snow and ice shall be removed from places to be occupied by concrete. Wood forms shall be wetted except in freezing weather or oiled, and the reinforcement cleaned of ice or other coatings.

C. Conveying, transporting, and placing shall be done as rapidly as practicable and without segregation, loss of ingredients, and without unnecessary rehandling. The tempering of concrete will not be permitted.

D. Concrete shall be deposited as nearly as practical to its final position to avoid segregation due to rehandling or flowing. The concreting shall be carried on at such a rate that the concrete is at all times plastic and workable and flows readily into the spaces between the reinforcing bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited on the work, nor shall retempered concrete be used. Once the concreting is started, it shall be carried on as a continuous operation until the placing of the panel or

section is completed. All concrete shall be compacted by suitable means during the placing operation, and thoroughly worked around reinforcement and embedded fixtures and into corners of the forms. Tremies shall be used for deep forms, and concrete shall not be dropped more than 6'-0".

E. Vibrating:
   1. During and immediately after depositing, all concrete shall be thoroughly compacted by vibrating the concrete internally with mechanical vibrating equipment. Care must be taken not to over-vibrate the concrete. Maintain spare vibrator(s) at the site for use in the event of breakdowns.
   2. Spade and work the coarse aggregate away from forms, and work concrete around reinforcement to avoid air pockets, voids, and honeycombed sections. Hand spading slabs will be required in addition to mechanical vibration.

F. During concreting, check shoring frequently with level. Strengthen or adjust shoring as required. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.

G. Placing of concrete in supported elements shall not be started until the concrete previously placed in columns and walls is no longer plastic and has been in place at least two hours.

H. Screed all work to level surfaces at the proper elevations. Rake surfaces to provide bond for floor finishes where specified.

I. No concrete shall be deposited under water without written permission of the Engineer and then only in accordance with his directions. Proper tremie equipment and techniques must be used, should the need arise.

J. The Contractor shall have available at all times, sufficient approved materials such that, when started, concrete shall be continuous operation until placement of panel or section is complete. Should placing of concrete be suspended or unavoidably interrupted once a pour has been started, provide bulkheads and keyways at formed surface at which to stop pour.

K. All laitance shall be removed from previous pours before additional concrete is placed.

L. Place concrete continuously between predetermined expansion, control and construction joints.

3.07 PROTECTION AND CURING

A. All concrete shall be protected against injury by sun, rain, freezing, mechanical damage, or premature drying. All concrete shall be maintained above 50°F in a moist or wet condition for at least the first 7 days after placement.

B. On vertical surfaces keep forms on, or cover with burlap blankets, kept wet. When forms are exposed to the sun, minimize moisture loss by keeping the forms wet until they can be removed safety.
   1. For the preservation of moisture, apply one of the following procedures to concrete not in contact with forms, immediately after completion of placement and finishing:
      a. continuous sprinkling
      b. application of absorptive mats or fabric kept continuously wet
      c. application of waterproof sheet materials as specified in Part 2, herein
      d. application of the curing agent specified in Part 2, herein

C. On horizontal surfaces and floors to receive later finishes, cover with wet burlap, wet sand, or curing paper and keep saturated. Cement finish floors shall be covered with protective covering material with lapped and sealed edges after the concrete has set sufficiently to carry worker's weight. Covering shall remain in place until floor is cleaned. Weight covering with planks as required to hold it in place.

D. Cold weather protection shall conform to A.C.I. 306R, except as modified herein.
   1. Prior to pouring, it shall be the Contractor's responsibility to keep the forms free from snow, ice, mud or debris at all times, by means of covers, enclosures, live steam or heating below the forms, as necessary. Use of torches, open flames, salts, straw, hay or chemical is prohibited.
   2. When air temperature is 40°F, or less, use only heated concrete, delivered to the forms at temperatures between 65°F and 85°F. All portions of freshly poured concrete shall be continually maintained at a temperature of not less than 50°F for seven days. Specified temperature shall be maintained by heated enclosures, insulating blankets, insulated forms, or whatever approved methods are required to attain the specified result.
   3. Concrete shall not be poured on frozen soil. After pouring, protect against freezing and heaving of subgrade. Any frozen concrete will be rejected and removed at the Contractor's expense. Accelerating admixtures shall not be accepted in lieu of winter protection.

E. Hot weather protection shall conform to ACI 305R, except as modified herein.
   1. During warm dry weather special care and precautions should be taken to prevent premature setting which may cause shrinkage and surface checking. No concrete shall be placed at temperatures above 90°F without approval of the Engineer.

F. No water (except curing spray) shall be allowed to come in contact with the concrete or masonry surface for a minimum of 24 hours. Should the rising water place a stress on the concrete, proper bracing shall be provided. Loading shall not occur without prior approval by the Engineer, and proper safety precautions shall be the responsibility of the Contractor.

G. Curing compound may be used as specified in Paragraph 2.1 provided discoloration does not occur and application is in accordance with manufacturer's direction and is compatible with concrete finish.

3.08 FOOTINGS AND MATS

A. Hand trim excavation to required levels.

B. Where shown on the drawings provide concrete mud mat to the thickness indicated.

C. Support reinforcing on bricks or precast blocks, or where mud mat is used, on chairs or bolsters, 3" clear of soil.

D. Columns and wall dowels shall be positioned, supported and tied in place before concrete is poured. Footing bottoms shall be inspected and approved by the Engineer before placing mud mat or footings.

3.09 SUPPORTED SLABS ON FORMS

A. Forms shall be built to required dimensions and camber as specified above. Reinforcing shall be located as shown on approved placing plans. Support bars at specified heights with bolsters, chairs, etc., so that reinforcing will not be moved from the specified position during placing of concrete.

B. Refer to Article 3.5 for installation of conduits.

3.10 SLABS ON GROUND

A. Subgrade and base to be prepared as specified in Contract Documents.

B. Form depressed ribs under partitions as required by sloping gravel, or provide permanent side forms to retain gravel.

C. Trench subgrade for electric conduit as detailed on Plans. All reinforcing shall be above electric conduit.

D. Place slabs of thickness shown on Plans, vibrate, screed, float level, and finish as specified below.

3.11 CONCRETE FINISHES - FORMED SURFACES

A. After the forms are removed, all concrete surfaces shall be inspected, and any poor joints, voids, stone pockets or other defective areas noted by the Engineer shall be repaired immediately at the Contractor's expense by cutting away the unsound area to a minimum depth of 1 inch, and refilling with mortar mixed using the same brand of cement as the original pour. Edges of the patch shall be square with the face, with feather-edging prohibited. Obtain approval of corrective action prior to repair.

B. Care shall be taken to saturate the patched area and holes shall be filled in 1/2-inch layers with a delay for an initial set to take place before the succeeding layer is applied. If, in the opinion of the Engineer, improper consolidation is too extensive, or if the structure appears weakened by the voids, complete removal of the concrete in question may be required. Patches shall be kept moist for a minimum of three days.

C. Rubbed finishes shall be as follows:

1. Type A: Surfaces shall be rubbed until all marks are obliterated and a uniformly smooth finish is obtained.
2. Type B: Surfaces shall be rubbed until they are uniformly smooth, but the complete obliteration of all marks is not required.
3. Type C: All fins, burrs and projections shall be removed, any honey-comb or tie-holes shall be filled and patched.

D. The type of finish to be used shall be as scheduled or as noted on the Plans. Where the type of finish is not shown or scheduled, exposed faces shall be given a Type B finish and unexposed faces shall be given Type C finish.

E. Rubbing shall begin as soon as practicable after removal of forms and shall be expedited to completion as rapidly as practicable.

F. Surfaces shall be rubbed with carborundum and water until all fins, bubbles, hollows and other defects are removed. Grout or mortar shall not be used in the rubbing process, and plastering of surfaces will not be permitted. Power tools shall be used for rubbing with hand work limited to inaccessible corners or very small areas.

3.12 FLOOR AND SLAB FINISHING

A. Finished floors and slabs shall be level to within 1/8" of finish floor elevation in ten feet. If this variation occurs, it must not be abrupt, but must taper so that the 1/8" variation takes place in not under 4 feet. Areas with drains shall have the surfaces sloped uniformly and true to the effect that no surface ponding occurs. If required by the Engineer, replace, grind or furnish underlayment to correct the variation, at the Contractor's expense. All floors and slabs shall be cured and protected as specified.

B. Troweled Finish: Provide a floated finish, followed by a power troweling and then a hand troweling thoroughly consolidating the surface. Provide a finished surface essentially free from trowel marks and uniform in texture and appearance.
   1. Where exposed concrete finish is specified, provide a steel troweled finish.
   2. Under quarry tile and ceramic tile screed to accurate lines and levels as required to receive these materials. Floors receiving tile are to be steel troweled finished and are indicated on the Plans.

C. Float Finish: A float finish shall be applied to all exterior concrete and those areas not intended for occupancy, such as culvert inverts, bottoms of manholes and catch basins, pads, etc.

D. Broom Finish: Provide a floated finish. While the surface is still plastic, provide a textured finish by drawing a fiber bustle broom uniformly over the surface in one direction only. Provide "medium" texturing unless noted otherwise on the Contract Drawings. Sidewalks, walkways, or exterior ramps shall be given a broom finish, perpendicular to traffic, sufficient to leave marks without appreciable disturbance of the surface.

E. Dusting with dry cement or cement sand mixtures, to hasten drying, is prohibited. Dry time shall be controlled by controlling the water content and slump of the concrete when placed.

3.13 BONDING

A. For the bonding of new and old concrete, such provisions shall be made by means of steps, dovetails, bonding agents as specified in Paragraph 2.1, or other devices as shown, or directed.

B. When placing of concrete is suspended or unavoidably interrupted, all necessary grooves for bonding future work shall be made before the concrete has attained its initial set. When the work is resumed, concrete previously placed shall be roughened, cleaned of all foreign material and laitance by means of sandblasting with steam and sharp sand or other approved methods, until coarse aggregate is exposed, and thoroughly wetted and slushed with mortar containing the same proportion of cement and fine aggregate as used in the concrete to be placed. Follow manufacturer's preparation recommendations when using a bonding agent.

3.14 MISCELLANEOUS CONCRETE WORK

A. Pour all sump pits, canopies, copings and provide all other miscellaneous concrete and cement work shown on the drawings. All such concrete shall be reinforced as shown. Provide all cement filled stair treads as detailed. Place bottoms and walls of pits and trenches monolithically or provide waterstops and keys.

B. Concrete Walks: Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet, unless otherwise indicated. Cut contraction joints 3/4-inch deep with a jointing tool after the surface has been finished. Provide 1/2-inch thick transverse expansion joints at changes in direction, where sidewalk abuts curb, steps, rigid pavement, or other similar structures. Provide a transverse slope of 1/4-inch per foot, and limit variation in cross section to 1/4-inch in 5 feet unless otherwise indicated.

C. Curbs and Gutters: Provide contraction joints spaced every 10 feet maximum, unless otherwise indicated. Cut contraction joints 3/4-inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2-inch thick and spaced every 100 feet maximum, unless otherwise indicated. Provide a broom finish.

D. Equipment Bases: Unless otherwise shown, all equipment shall be erected on bases of Class "B" concrete. Thickness shall be as noted on the Plans, but at no time shall it measure less than 1 inch.

E. Concrete Stairs, Steps and Platforms: Stairs, steps and platforms shall be formed to required profiles shown on the Plans. Place reinforcing as required. Finish of stairs and steps shall be monolithic. Where shown on Plans, provide for nosings. Exterior stairs, steps and platforms shall have a non-slip finish. Before final troweling, embed abrasive grits, as specified in Paragraph 2.1, in the surface.

3.15 CEMENTITIOUS COATING

A. Cementitious Coating shall be applied to all exposed exterior and interior Cast-In-Place Concrete surfaces except concrete floors and walking surfaces in accordance with the schedule shown on the Plans, or otherwise directed.

B. The surfaces to be coated shall be clean, free of all laitance, dirt, grease, curing compound, form treatments, efflorescence, paint and other foreign matter. All formed tie-rod holes and honeycombed areas shall be patched flush with the surrounding area using mortar as recommended by cementitious coating manufacturer.

C. All areas scheduled to be coated will receive two coats of cementitious coating as specified in Paragraph 2.1, applied at a minimum rate of 2 pounds per square yard per coat. The first coat shall be allowed to set before the second coat is applied. Sufficient materials shall be applied to fully seal all pores and voids. All coatings shall be done strictly in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 04 22 01

UNIT MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Unit Masonry, including accessory items of work herein described, as shown on the Plans, as specified and/or directed.

1.02 APPLICABLE SPECIFICATIONS, CODES AND STANDARDS

A. Reference to standard specifications for the following organizations is intended to specify minimum standards for quality of materials and performance of workmanship, and for standard test methods.
   1. American Society for Testing and Material (ASTM) Latest Edition.
   2. American Concrete Institute (ACI) and American Society of Civil Engineers (ASCE), Building Code Requirements For Masonry Structures, Latest Edition.
   3. National Concrete Masonry Association (NCMA) Specifications, Latest Edition.

1.03 SUBMITTALS: Submit the following.

A. Design Data:
   1. Pre-mixed mortar mix design
   2. Grout mix design

B. Manufacturer's Catalog Data:
   1. Masonry accessories
   2. Reinforcement
   3. Pre-mixed mortar
   4. Control joints
   5. Expansion joints
   6. Water-repellent admixture
   7. Flashing
   8. Grout

   Submit for each type.

C. Drawings:
   1. Reinforcing steel
   2. Accessories

Indicate splicing, laps, shapes, dimensions, and details of reinforcing bars and accessories. Include details of anchors, adjustable wall ties, positioning devices, bond beams, and lintels. Do not scale drawings to determine lengths of bars.

D. Manufacturer's Instructions:
   1. Masonry cement

   If masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

E. Samples:
   1. Masonry units
   2. Mortar colors
   3. Wall reinforcement
   4. Anchors
   5. Wall ties

   Submit five representative full size masonry units showing full range of color, texture, finish, and dimensions, two samples of each color of mortar, and two samples of each type of wall reinforcement, anchor, and wall tie.

F. Sample Panel:
   1. Masonry panel

   At the job site submit for approval by the Engineer, a sample masonry panel approximately 6 feet long by 4 feet high showing the workmanship, coursing, bond, weep holes, flashing, thickness, anchors, joint reinforcing, wall ties, rigid-board insulation, intersection of walls, bond beams, expansion and control joint, and tooling of joints, range of color, texture of masonry, and mortar color.

G. Factory Test Reports:
   1. Efflorescence test

   Submit efflorescence test reports on masonry units that are to be exposed to weathering. Schedule tests far enough in advance of starting masonry work to permit retesting if necessary. Test five pairs of specimens of each type of masonry unit for efflorescence in accordance with ASTM C67. If any pair is rated "effloresced," reject the units represented by the samples.

H. Certificates of Compliance: The Contractor shall submit to the Engineer prior to delivery, manufacturer's or supplier's certification of compliance of units with specified standards, as determined by an acceptable testing agency conforming to the applicable requirements of ASTM.
   1. Masonry cement
      a. Grout
      b. Pre-mixed mortar
      c. Compressive strength tests for block and brick

1.04 QUALITY ASSURANCE

A. Appearance: Do not change source or supply of materials after the work has started if the appearance of the finished work would be affected. Units should be sound and free from cracks or other defects that would interfere with proper setting, impair strength and performance of construction, or be objectionable in appearance.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver cementitious materials to the site in unbroken containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious materials in dry, weathertight sheds or enclosures and handle so as to prevent entry of foreign materials and damage by water or dampness. Store masonry units off the ground and handle with care to avoid chipping and breakage. Protect materials from damage and, except for sand, keep dry until used. Cover sand to prevent intrusion of water and foreign materials and to prevent drying. Do not use materials containing frost or ice.

1.06 ENVIRONMENTAL CONDITIONS

A. Cold Weather Construction: During cold weather, that is when the air temperature is below 40 degrees F and falling, or when it appears that the air temperature will drop to 40 degrees F or below within 24 hours, do not lay masonry unless the work is protected from freezing as specified below. Surfaces receiving mortar shall be free of ice and frost. Comply with the requirements specified below for the respective air temperatures:
   1. Air Temperature 40 to 25 Degrees F: Heat sand or mixing water to produce mortar temperature between 40 and 120 degrees F.
   2. Air Temperature 25 to 20 Degrees F: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F. Use salamanders or other heat sources on both sides of walls under construction. Use windbreaks when wind is in excess of 15 mph.
   3. Air Temperature 20 Degrees F and Below: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F. Provide enclosures and auxiliary heat to maintain air temperature above 32 degrees F on both sides of walls under construction. Ascertain that temperatures of masonry units are not less than 20 degrees F when units are laid.

B. Cold Weather Protection: Protect newly laid masonry as specified below for the respective mean daily air temperature (MDAT), that is, the average of the daytime high temperature and the forecasted nighttime low temperature.
   1. MDAT 40 to 25 Degrees F: Protect masonry from rain and snow by covering with weather-resistive membrane for 24 hours after laying.
   2. MDAT 25 to 20 Degrees F: Completely cover newly-laid masonry with insulating blankets and weather-resistive membrane for 24 hours.

3. MDAT 20 Degrees F and Below: Maintain temperature of masonry above 32 degrees F for 24 hours by providing enclosures and supplementary heat or other approved means.

1.07 SCHEDULING:

A. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching.

PART 2 - PRODUCTS

2.01 MASONRY UNITS

A. Facing Brick: ASTM C216, Grade SW, Type FBS, 3-3/4 inches thick, 2-1/4 inches high, and 8 inches long (standard) or 3-5/8 inches thick, 2-1/4 inches high, and 7-5/8 inches long (modular). The color, texture, and range of facing brick shall match as closely as possible the existing building brick as approved by the Engineer and Owner. The color and texture shall be within the range of variation resulting from good manufacturing practices on a single lot of brick. Brick shall be manufactured at one time and stockpiled before beginning shipments to the job site.

B. Concrete Masonry Units: Units shall be of modular dimensions and be steam cured, or approved equal. Exposed surfaces of units shall be comparatively smooth and of uniform texture.
1. Hollow and Solid Load-Bearing Units: ASTM C90, normal weight. Provide units for all load-bearing masonry construction including exterior walls, interior walls, foundation walls, and shear walls. Minimum net area compressive strength of concrete masonry units shall not be less than 2650 psi.

C. Water-Repellant Admixture: Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units and mortar which contain the water-repellant admixture. When tested in accordance with ASTM E72, such panels shall be flexural strength not less than 20 percent greater, and compressive strength not less than 3 percent greater, than similar panels which do not contain the admixture. When tested in accordance with ASTM E514, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.

2.02 MORTAR

A. Provide mortar of the type and color specified, and in conformance with ASTM C270, Standard Specification for Mortar and Unit Masonry, and BIA Technical Notes on Brick Construction No. 8 – Mortars for Brickwork.

B. Portland Cement: Provide in accordance with ASTM C150, Standard Specification for Portland cement, Type I. Type II, or III Portland Cement may be acceptable under conditions approved by the Engineer.

C. Hydrated Lime: Provide in accordance with ASTM C207, Standard Specification for Hydrated Lime for Masonry Purposes, Type S.

D. Masonry Cement: ASTM C91, except that for masonry cement used in mortar for exterior walls, the air content of the mortar specimen shall be not more than 16 percent by volume in lieu of 22 percent. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

E. Sand: ASTM C144. The sand in combination with the cementitious materials shall produce a mortar of the specified color.

F. Water: Clean, potable, and free from substances which could adversely affect the mortar.

G. Mortar Types: ASTM C270, Type M for foundation walls, bearing walls, exterior walls, basement walls, and piers; Type N or S for non-load-bearing, non-shear-wall interior masonry; and Type S for all other masonry work; except where higher compressive strength is indicated on structural drawings. Air content shall be limited to 12 percent.

H. Mortar Mix: Mortar mixes provided shall be based on the properties specification method in accordance with ASTM C270 for the mortar "Type" specified. Air content shall be limited to 12 percent for "Cement/Lime" and "Mortar Cement" mixed mortars and 18 percent for "Masonry Cement" mixed mortars.

I. Admixtures: No air-entraining admixtures, anti-freeze compounds or calcium chlorides shall be included in mortar. Where colored mortar is indicated, add pigment to obtain the color indicated. Mortar colors shall consist of inorganic compounds not to exceed 15% of the weight of the cement. Admixtures may be used in mortar to retard curing and provide up to 36 hours of workability, provided the admixture does not adversely affect bonding or compressive strength.

2.03 GROUT

A. Grout for reinforced masonry shall be proportioned and mixed in accordance with ASTM C476. Fine grout (with sand aggregate) shall be used in grout spaces where minimum horizontal dimension is less than 4 inches. Coarse grout (with pea gravel) may be used elsewhere. Samples shall be tested in accordance with applicable portions of ASTM C1019 and shall exhibit a minimum ultimate compressive strength of 2500 psi at 28 days. Do not use admixtures that contain calcium chlorides, air-entrainment or antifreeze compounds.

2.04 ACCESSORIES

A. Horizontal Joint Reinforcement: Fabricate from cold drawn steel wire, ASTM A82. Wire shall be hot-dipped galvanized after fabrication in accordance with ASTM A153 (1.5 oz of zinc per square foot). Reinforcement shall be truss type with two or more longitudinal wires welded to a continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c. Provide flat sections 10 feet long, and preformed corners and tees approximately 30 inches long. Overall width shall be approximately 2-inches less than nominal thickness of wall.
   1. Single-Wythe: For single-wythe walls and partitions, provide two 9-gauge (0.1483-inch) longitudinal wires and 9-gauge cross wires.

B. Cavity Wall Veneer Anchor and Tie Type 1: At cavity walls with wood sheathed stud framing, or CMU back-up construction, provide adjustable two piece steel eye and pintle veneer anchor and tie designed to be attached through rigid insulation to CMU, concrete, and wood stud/sheathing back-up construction. Eye and pintle shall be compatible when used together, and shall be supplied from the same manufacturer. Maximum play between pintles and eyes shall be 1/16 inch. Vertical misalignment between eye and pintle shall be 1 ¼-inch maximum.
   1. Anchor (Eye): Provide anchors with an ASTM A580 – AISI type 304 stainless steel barrel and factory installed EPDM washer and plastic encapsulated steel wing “eye” section receivers with an ASTM C954 (1,000-hour) polymer coated 5/16-inch diameter hex head ASTM A510 carbon steel screw fastener. Provide anchors as manufactured by Hohmann & Barnard, Inc, Type: 2-Seal Thermal Concrete Wing Nut Anchor, or approved equal.
   2. Tie (Pintel): Provide two (vertical) leg hooked ties fabricated from carbon steel conforming to ASTM A1064 (80,000 psi tensile strength / 70,000 psi yield point), hot dip galvanized after fabrication in accordance with ASTM A153 – B2 (2.0 oz/ft2), and TMS 402/ACI 530/ASCE 5/TMS 602/ACI 530.1/ASCE 6. Ties shall be 3/16-inch diameter x length per TMS 402/ACI 530/ASCE 5/TMS 602/ACI 530.1/ASCE 6 for tie cover and embedment requirements. Ties shall be as manufactured by Hohmann & Barnard, Inc, Type: 2X-Hook, or approved equal.

C. Cavity Wall Veneer Anchor and Tie Type 2: At structural steel frame back-up to cavity wall veneer construction provide adjustable two piece steel metal "weldable" anchor and wire tie.

D. Anchors and Ties: Provide approved designs of stainless steel, zinc-coated steel, or noncorrosive metal having the equivalent total strength of steel types. Zinc coat steel by the hot-dip process after fabrication to a minimum of 1.25 ounces of zinc per square foot of surface when tested in accordance with ASTM A90.
   1. Corrugated Metal Ties: Not less than 7/8-inch wide by approximately 7 inches long and not lighter than 22 gauge.
   2. Rigid Steel Anchors: Not less than 1-1/2 inches wide, 1/4-inch thick, and 24 inches long with each end bent not less than 2 inches.
   3. Wire Mesh: Minimum 20 gauge, 1/2-inch mesh, galvanized wire, 1 inch less in width than width of masonry.
   4. Dovetail Flat Bar or Wire Anchors: Flat bar: corrugated sheet steel, not lighter than 16 gauge, and 7/8-inch wide, with end turned up 1/4 inch. Wire: not lighter than 6 gauge, 7/8-inch wide with wire looped and closed. Dovetail slots and inserts are specified in Section 03 30 00, "Cast-in-Place Concrete".

E. Fastenings: Build in bolts, metal wall plugs, and other metal fastenings furnished under other sections for securing furring and other items.

F. Reinforcing Bars: Vertical steel and dowel reinforcing shall be 60,000 psi and conform to ASTM A615 as specified in Section 03 21 00.

G. Through-Wall Flashing: Provide one of the following types except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing and except that the material shall be one which is not adversely affected by the material used for dampproofing.
   1. Coated-Copper Flashing: 5-ounce, electrolytic copper sheet, uniformly coated on both sides with acid-proof, alkali-proof, elastic bituminous compound. Factory apply coating to a weight of not less than 6 ounces per square foot (approximately 3 ounces per square foot on each side).
   2. Minimum 5-Ounce Copper or Stainless Steel Flashing: Copper, ASTM B370, 6-ounce weight; stainless steel, ASTM A167, Type 301, 302, 304, or 316, 0.006-inch thick, No. 2 or No. 2D finish. Provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.
   3. Plastic Flashing: Homogeneous, waterproof, impermeable, elastomeric sheeting not less than 0.030-inch thick. Sheeting shall have not less than 1000 pounds per square inch tensile strength, nor more than 7 percent tension set at 50 percent elongation when tested in accordance with ASTM D412. Suitably stabilize sheeting to resist exposure without

visible deterioration when tested not less than 400 hours in accordance with ASTM D822. The material, after being exposed for not less than 1/2 hour to a temperature of minus 20 degrees F, shall show no cracking or flaking when, at that temperature, it is bent 180 degrees over a 1/32-inch diameter mandrel and then bent at the same point over the same size mandrel in the opposite direction 360 degrees and not be subject to rapid ultraviolet degradation.

4. Reinforced Membrane Flashing: Polyester film core with a reinforcing fiberglass scrim bonded to one side. The membrane shall be impervious to moisture, flexible, and not affected by caustic alkalis. The material, after being exposed for not less than 1/2 hour to a temperature of 32 degrees F, shall show no cracking when, at that temperature, it is bent 180 degrees over a 1/16-inch diameter mandrel and then bent at the same point over the same size mandrel in the opposite direction 360 degrees.
5. Embossed Membrane Flashing: Polyester film embossed in a small hexagon pattern, impervious to moisture and resistant to corrosion. Film shall not become brittle and shall remain flexible for thermal movements within wall.

H. Wicking for Weep Holes: Fiberglass, 1/4 inch in diameter, each piece not less than 18 inches long.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protection:
1. Stains: Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.
2. Loads: Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed.
3. Provide temporary bracing as required to prevent damage during construction.
4. Polyester Embossed Film: Provide protective boards for polyester film during job installation to ensure no damage from building debris.

B. Surface Preparation: Surfaces on which masonry is to be placed shall be smooth, clean, and free of foreign substances when mortar is applied.

3.02 WORKMANSHIP

A. Carry masonry up level and plumb. Furnish and use story poles or gauge rods throughout the work. Changes in coursing or bonding after the work is started will not be permitted. Do not carry one section of the walls up in advance of the others. Step back unfinished work for joining with new work. Toothing will not be permitted. Check heights of masonry with an instrument at each floor and at sills and heads of openings to maintain the level of the walls. Build in door and window frames, louvered openings, anchors, pipes, ducts, and conduits as the masonry work progresses. Fill spaces around metal door frames solidly with mortar. Handle masonry units with care to avoid chipping, cracking, and spalling of faces and edges. Drilling, cutting, fitting, and patching to accommodate the work of others shall be performed by masonry mechanics. Cut masonry with masonry saws for exposed work. Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels, and miscellaneous metalwork specified elsewhere shall be placed in position as the work progresses. Provide chases of approved dimensions for pipes and other purposes where indicated and where necessary. Inspect scaffolding regularly to ensure that it is amply strong, well braced, and securely tied in position. Do not overload scaffolding.

3.03 MORTAR MIXING

A. Measure mortar materials in 1 cu. ft. containers to maintain control and accuracy of proportions. Do not measure materials with shovels. Mix mortar in a mechanical batch mixer for not less than 3 nor more than 5 minutes after all ingredients are in so as to produce a uniform mixture. Add water gradually as required to produce a workable consistency. Do not load mixer beyond its rated capacity. Keep mortar boxes, pans, and mixer drums clean and free of debris and dried mortar. Retemper mortar which has stiffened because of evaporation by adding water and mixing to obtain a workable consistency. Do not use or retemper mortar which has not been placed in final position within 2-1/2 hours after the initial mixing. Do not use antifreeze compounds, salts, or other substances to lower the freezing point of mortar.

1. Mortar: Mix mortar in accordance with ASTM C270 to obtain type mortar required. Where colored mortars are required, pigments may be added at the site or provided as part of prepackaged mortar mix. When masonry cement is used, conform to printed mixing instructions of the masonry cement manufacturer. During mixing, add water-repellant admixture in quantity recommended by the admixture manufacturer to mortar which will be used in exterior concrete masonry unit walls.
2. Grout: ASTM C476. Provide fine grout in grout spaces less than 2 inches in any horizontal dimension or in which clearance between reinforcing and masonry is less than 3/4 inch. Provide coarse grout in grout spaces 2 inches or greater in all horizontal dimensions provided the clearance between reinforcing and masonry is not less than 3/4 inch.

3.04 MORTAR JOINTS

A. Uniform thickness of 3/8 inch unless otherwise indicated. Tool exposed joints slightly concave with a round or other suitable jointer when the mortar is thumb print hard. For horizontal joints, jointers shall be at least 12 inches long for brickwork and 16 inches long for concrete masonry. Jointers shall be slightly larger than the width of the joint so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Strike flush joints that will not be exposed. Tool vertical joints first. Brush joints to remove all loose and excess mortar. Horizontal joints shall be level; vertical joints shall be plumb and in alignment from top to bottom of wall within a tolerance of plus or minus 1/2 inch in 40 feet.

3.05 TOLERANCES

A. Masonry work shall be within the following limits:
   1. Pilasters and Columns: 1/4 inch from true line.
   2. Face of Brick: 1/32 inch from face of adjacent brick.
   3. Face of Concrete Masonry Unit: 1/16 inch from face of adjacent unit.
   4. Variation From True Plane: 1/4 inch in 10 feet and 1/2 inch maximum in 20 feet or more.
   5. Variation From Plumb: 1/4 inch in each story, noncumulative and 1/2 inch maximum in two stories or more.
   6. Variation From Level: 1/8 inch in 3 feet, 1/4 inch in 10 feet, and 1/2-inch maximum.
   7. Variation in Wall Thickness: Plus or minus 1/4 inch.

3.06 BRICKWORK

A. Provide brickwork that conforms to requirements of paragraph entitled "Tolerances" of this Section. Select and place brick so that better face of stretchers and headers are exposed.
   1. Testing: Except during cold weather, as defined under Environmental Conditions, test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested. Ensure that each brick is nearly saturated 24 hours prior to placement and surface dry when laid. During cold weather, brick units that require wetting shall be sprinkled with warm or hot water just before laying.
   2. Application: Unless indicated or specified otherwise, lay brick in running bond. Fill joints between bricks completely with mortar. Form bed joints of a thick layer of mortar slightly furrowed. Form head joints by applying a full coat of mortar on the brick to be laid. The practice of slushing head joints will not be permitted. Lay closure bricks with mortar on all bedding

surfaces of unit to be laid and units in place. Place the brick carefully without disturbing the brick previously laid. Dry or butt joints will not be permitted. Provide grouting as specified.

3. Brick-Faced Walls: Bond the two wythes in every sixth brick course with continuous horizontal joint reinforcement. Provide additional bonding ties spaced not more than 3 feet apart around the perimeter of and within 12 inches of all openings.
   a. Collar Joints: Fill collar joints solid with mortar as each course of brick is laid. Do not disturb units in place.
   b. Brick Sills: Lay brick on edge, slope, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.
4. Cavity Walls: Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings. At the bottom of cavity walls, in the course immediately above the through-wall flashing, temporarily omit one brick every 4 feet. With a hose and clean water, wash all mortar droppings and debris out of the cavity through the temporary openings at least twice each day masonry is laid, and more often if required to keep the cavities clean. Fill in the openings with bricks and mortar after the wall is complete and the cavity has been inspected and found clean. Provide weep holes of open head joints spaced 24 inches o.c. wherever the cavity is interrupted.

3.07 CONCRETE MASONRY UNIT WORK

A. Lay the first course in a full bed of mortar for the full width of the unit. Lay succeeding courses in running bond unless otherwise indicated. Form bed-joints by applying the mortar to the entire top surfaces of the inner and outer face shells. Form head joints by applying the mortar for a width of about 1 inch to the ends of the adjoining units. The mortar shall be of such thickness that it will be forced out of the joints as the units are placed in position. Where anchors, bolts, and ties occur within the cells of the units, place metal lath in the joint at the bottom of such cells, and fill the cells with mortar or grout as the work progresses. Use solid block for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as required. No wetting of concrete masonry units is permitted.

1. Reinforced Concrete Masonry Unit Walls: Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. The cells to be grouted must be fully bedded in mortar, including the webs to prevent leakage. Remove mortar fins protruding from joints before grout is placed. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at

vertical intervals not to exceed 160 bar diameters. Grouting shall be performed as soon as possible after placing units so shrinkage cracking at the joints is minimized and so the grout bonds with the mortar. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.08 BONDING AND ANCHORING

A. Unless indicated otherwise, extend partitions from the floor to the bottom of the construction above. Structurally bond or anchor walls and partitions to each other and to concrete walls, beams, and columns. Securely anchor non-load-bearing partitions and interior walls to the construction above in a manner that provides lateral stability while permitting unrestricted deflection of construction above. Completely embed anchors in mortar joints. Partial height partitions, less than height of ceiling, should be capped with solid (not filled) masonry units.

1. Corners of Load-Bearing Walls: Provide a true masonry bond in each course, except where indicated or specified otherwise.
2. Intersections of Load-Bearing Walls: Provide a true masonry bond in each course, or anchor with rigid steel anchors not more than 2 feet apart vertically, unless otherwise indicated.
3. Intersections of Non-Load-Bearing Partitions With Other Walls or Partitions: Tie with wire mesh ties at vertical intervals of not more than 2 feet or with masonry bonding in alternate courses, unless otherwise indicated.
4. Masonry Walls Facing or Abutting Concrete Members: Anchor masonry to the concrete with dovetail or wire-type anchors inserted in slots or inserts built into the concrete, unless otherwise indicated. Locate anchors not more than 18 inches o.c. vertically and not more than 24 inches o.c. horizontally.
5. Brick Veneer on Wood Frame: Provide corrugated metal ties nailed to wood studs at 16 inches o.c. both ways.

3.09 THROUGH-WALL FLASHING

A. Provide as indicated. Unless indicated otherwise, extend flashing from a point 1/4-inch outside of the exterior face of walls, upward in collar joint across wall cavity into reglets. Bend down the exterior edge to form a drip. Flashing shall be terminated 3/4-inch back from interior face of walls and turned back on itself not less than 1/2-inch extended beyond interior face of wall and turned up not less than 2 inches. Secure flashing in reglets to ensure a permanent watertight joint. Provide flashing in lengths as long as practicable. Lap ends not less than 1-1/2 inches for interlocking type and 4 inches for other types. Seal laps as necessary to ensure watertight construction. Provide dams at ends of flashing where masonry abuts concrete and where flashing ends within the masonry.

3.10 WEEP HOLES

A. Wherever through-wall flashing occurs, provide weep holes to drain the flashing to the exterior. Weep holes shall be open head joints 24 inches o.c., clear round holes not less than 1/4 inch in diameter and 24 inches o.c., or 1/4-inch diameter wicking 16 inches o.c. Wicking shall extend from the exterior face of the masonry to and approximately 2 inches upward into the cavity or collar joint.

3.11 CONTROL JOINTS

A. Provide where indicated in concrete masonry-unit walls. Provide sawed type or built-in type as required. Joints shall occur directly opposite each other on both faces of the wall and shall be filled with sealant as specified in Section 07 92 00, "Joint Sealants".

3.12 EXPANSION JOINTS

A. Provide where indicated in brick walls. Fill joints with a permanently flexible preformed filler material and a sealant as specified in Section 07 92 00, "Joint Sealants".

3.13 GROUT PLACEMENT

A. Grouting is required at voids where reinforcing is provided and in below grade foundation walls. Refer to drawings for locations.

B. Place grout from the interior side of walls, except as approved otherwise. Protect sills, ledges, offsets, and other surfaces from grout droppings. Remove grout from such surfaces immediately. Grout shall be well mixed to prevent segregation and shall be sufficiently fluid to flow into joints and around reinforcing without leaving voids. Place grout by pumping or pouring from buckets equipped with spouts in lifts not exceeding 5 feet. Waiting time before subsequent pours of grout shall be thirty (30) to sixty (60) minutes, to prevent rupture of the masonry due to hydraulic pressure on the lower mortar joints and/or concrete blocks and to allow for settlement, shrinkage and absorption of excess water by the units. Keep pours at 1-1/2 inches below the top of masonry units in top course, except at the finish course. Puddle or agitate grout thoroughly to eliminate voids. Remove masonry displaced by grouting operation and re-lay in alignment with fresh mortar.

3.14 FORMS AND SHORING

A. Construct to the shape, lines, and dimensions of members indicated and make sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry. Do not remove until members have cured.

3.15 PARGING

A. Parge the outside of masonry basement walls in contact with the earth with two coats of Type M mortar, each 3/8-inch thick. Cross-scratch the first coat and allow to cure at least 24 hours. Trowel smooth the second coat, bevel at top, and cove out to edge of footing. Extend parging not more than 4 inches above grade, unless indicated otherwise, and keep damp for at least 3 days.

3.16 CLEANING

A. Protection: Protect work which may be damaged, stained, or discolored during cleaning operations.

B. Pointing: Upon completion of masonry work and before cleaning, cut out defective mortar joints and tuck point joints and all holes solidly with prehydrated mortar.

C. Cleaning: Clean exposed masonry surfaces with clear water and stiff fiber brushes and rinse with clear water. Where stains, mortar, or other soil remain, continue scrubbing with warm water and detergent. Where soil still remains on brickwork, continue cleaning as follows: Thoroughly wet exposed surfaces of dark-colored brickwork with clear water and scrub with stiff fiber brushes and a solution of not more than 1 part of muriatic acid to 9 parts of water applied to an area of 15 to 20 square feet at a time. Clean light-colored brickwork surfaces with non-acid or buffered-acid cleaners as recommended by the brick manufacturer. Use cleaners in accordance with the instructions and recommendations of the brick and cleaner manufacturers. Immediately after cleaning each area, rinse thoroughly with clear water. Restore damaged, stained, and discolored work to original condition or provide new work.

END OF SECTION

SECTION 05 12 01

STRUCTURAL STEEL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall provide all labor, materials and equipment required to furnish, fabricate, deliver and erect Structural Steel as shown on the Plans, as specified, and/or directed.

B. Included are lintels, angles, anchor bolts for column bases, bearing plates, columns, beams, girders, bracing, clips, hangers and other framing.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Association of State Highway and Transportation Officials (AASHTO) Publication:
   a. Standard Specifications for Highway Bridges
2. American Institute of Steel Construction (AISC) Publications:
   a. Manual of Steel Construction
   b. Manual of Steel Construction - Load and Resistance Factor Design
   c. Detailing for Steel Construction
   d. Engineering for Steel Construction
3. American National Standards Institute (ANSI) Publication:
   a. B46.1 Surface Texture (Surface Roughness, Waviness and Lay)
4. American Railway Engineering Association (AREA) Publication:
   a. Manual for Railway Engineering (Fixed Properties)
5. American Society for Testing and Materials (ASTM) Publications:
   a. A36/A36M Structural Steel
   b. A53 Steel Pipe, Hot-Dipped, Zinc-Coated Welded and Seamless
   c. A108 Steel Bars, Carbon, Cold-Finished, Standard Quality
   d. A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   e. A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   f. A242/A242M High-Strength Low-Alloy Structural Steel
   g. A307 Carbon Steel Externally Threaded Standard Fasteners

h.	A325	High-Strength Bolts for Structural Steel Joints
i.	A449	Quenched and Tempered Steel Bolts and Studs
j.	A490	Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
k.	A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
l.	A501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
m.	A514/A514M	High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
n.	ASTM A529/ A529M	Structural Steel with 42 ksi Minimum Yield Point (1/2-Inch Maximum Thickness)
o.	A563	Carbon and Alloy Steel Nuts
p.	A568/A568M	General Requirements for Steel, Carbon and High Strength Low-Alloy Hot-Rolled Sheet and Cold-Rolled Sheet
q.	A572/A572	High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
r.	A588/A588M	High-Strength Low-Alloy Structural Steel With 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
s.	A618	Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
t.	A668	Steel Forgings, Carbon and Alloy, for General Industrial Use
u.	A780	Repair of Damaged Hot-Dip Galvanized Coatings
v.	A992/A992M	High Strength Low-Alloy Structural Steel With 50 ksi (345 MPa) Minimum Yield Point
w.	B695	Coatings of Zinc Mechanically Deposited on Iron and Steel
x.	C827	Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
y.	F436	Hardened Steel Washers
z.	F844	Washers, Steel, Plain (Flat), Unhardened for General Use
aa.	F959	Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners

6. American Welding Society, Inc. (AWS) Publication:
   a. D1.1 Structural Welding Code - Steel

7. Crane Manufacturers Association of America (CMAA) Specification:
   a. 70 Electric Overhead Traveling Cranes
   b. 74 Top Running and Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist
8. Steel Structures Painting Council (SSPC) Publications:
   a. PA 1 Shop, Field, and Maintenance Painting
   b. Paint 25 Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer
   c. SP 2 Hand Tool Cleaning
   d. SP 3 Power Tool Cleaning
   e. SP 6 Commercial Blast Cleaning

1.03 SYSTEM DESCRIPTION

A. Provide the structural steel system, including shop primer, galvanizing, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, and testing shall be provided in accordance with AISC "Manual of Steel Construction", and/or "Manual of Steel Construction - Load and Resistance Factor Design", except as modified in this Section.

1.04 MODIFICATIONS TO REFERENCES

A. The "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings", including Supplement No. 1; the "Code of Standard Practice for Steel Buildings and Bridges", and "Structural Joints Using ASTM A325 or A490 Bolts" except as modified in this Section, shall be considered a part of the AISC "Manual of Steel Construction" and is referred to in this Section as the AISC "Manual of Steel Construction". The "Load and Resistance Factor Design Specification for Structural Steel Buildings", the "Code of Standard Practice for Steel Buildings and Bridges", the "Load and Resistance Factor Design Specifications for Structural Joints Using ASTM A325 or A490 Bolts", and the "Allowable Stress Design Specification for Structural Joints Using ASTM A325 or A490 Bolts" including Appendix A shall be considered a part of the AISC "Manual of Steel Construction - Load and Resistance Factor Design" and is referred to in this Section as the AISC "Manual of Steel Construction - Load and Resistance Factor Design".

1.05 SUBMITTALS

A. Shop Drawings: Submit for approval prior to fabrication. Prepare in accordance with AISC "Detailing for Steel Construction" and AISC "Engineering for Steel Construction". Shop drawings shall not be reproductions of Contract Drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard

welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted with calculations, as part of the shop drawings. Review of shop drawings shall be for size and arrangement of principal and auxiliary members and strength of connections. Dimensions and proper fit shall be the responsibility of the Contractor.

B. Erection Plan: Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

C. Manufacturer's Data: Submit for the following:
   1. Shop primer, including test report for Class B primer.

D. Certificates of Compliance: Submit for the following:
   1. Steel
   2. Bolts, nuts, and washers
   3. Shop primer
   4. Welding electrodes and rods
   5. Nonshrink grout
   6. Galvanizing

E. Welder's, Welding Operator's, and Tacker's Qualifications: Prior to welding, submit certification for each stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

PART 2 - PRODUCTS

2.01 STEEL

A. Structural Steel: ASTM A36.

B. High-Strength Low-Alloy Structural Steel: ASTM A572, Grade 50.

C. Structural Steel Tubing: ASTM A500, Grade B.

D. Steel Pipe: ASTM A53, Type E or S, Grade B, weight class STD (Standard); ASTM A501.

E. Sag Rods: ASTM A36.

2.02 BOLTS, NUTS, AND WASHERS

A. Provide the following unless indicated otherwise.

B. Structural Steel Joints:

1. Bolts: ASTM A325, Type 1; ASTM A490, Type 1 or 2.
2. Nuts: ASTM A563, Grade C and heavy hex style or as specified in the applicable ASTM bolt standard.
3. Washers: ASTM F436, plain carbon steel.

C. Weathering Structural Steel Joints:
1. Bolts: ASTM A325, Type 3; ASTM A490, Type 3.
2. Nuts: ASTM A563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A325 bolts.
3. Washers: ASTM F436, weathering steel.

D. Foundation Anchorage:
1. Bolts: ASTM A307, Grade A.
2. Nuts: ASTM A563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A325 bolts.
3. Washers: ASTM F436, weathering steel.

2.03 STRUCTURAL STEEL ACCESSORIES

A. Welding Electrodes and Rods: AWS D1.1. Welding rods for manual shielded metal arc-welding shall conform to E-70 series of ASTM A233.

B. Nonshrink Grout: Grout shall be nonmetallic such as "Embeco" as manufactured by Master Builders, "Intraplast" as manufactured by Sika, or equal.

2.04 SHOP PRIMER

A. SSPC Paint 25, except provide a Class B coating in accordance with AISC "Manual of Steel Construction" for slip critical joints.

2.05 GALVANIZING

A. ASTM A123 or A153, as applicable, unless specified otherwise galvanize after fabrication where practicable. Touch up primer for galvanized surfaces SSPC 20, Type I.

2.06 FABRICATION

A. Markings: Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Manufacturer's symbol and grade markings shall appear on all bolts and nuts.

B. Shop Primer: Shop prime structural steel, except as modified herein, in accordance with SSPC-PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, or surfaces within 0.5 inch of the toe of the welds prior to

welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Engineer.

1. Cleaning: SSPC SP 2 or 3, except that exposed exterior steel surfaces shall be cleaned in accordance with SSPC SP 6. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.
2. Primer: Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. After erection, repair damaged primed surfaces with an additional coat of primer.

C. Gas cutting may be used for concealed or minor items of work, i.e.: blocking, etc., but will not be allowed for cutting or enlarging of bolt holes. Bearing ends of columns shall be accurately milled to a plane surface perpendicular to the axis of the shaft.

D. Provide holes required for use of other trades that can be determined prior to fabrication of structural steel.

PART 3 - EXECUTION

3.01 ERECTION

A. Column baseplates and leveling plates shall be set level to correct elevations and temporarily supported on steel wedges or shims until the supported members have been plumbed and grouted.

B. After final positioning of steel members, provide full bearing under baseplates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions. The entire bearing area under the plates shall be grouted solid.

C. Templates shall be furnished as required for the accurate placement of anchor bolts and bearing plates.

D. Structural steel framing shall be carried up true and plumb, and temporary bracing shall be used wherever necessary to withstand all loads to which the structure may be subjected, including erection equipment and its operation. Bracing shall be left in place as long as may be required for safety and then removed by the

Contractor. As erection progresses, the work shall be securely connected to take care of all dead load, wind and erection stresses.

3.02 CONNECTIONS

A. Except as modified in this Section, connections not detailed shall be designed in accordance with AISC "Manual of Steel Construction". Build connections into existing work. Shop connections shall be welded. All connections shall be properly designed for the moments or shears shown on the drawing, or for the standard end loads of the members to be connected as tabulated for uniform loads in the AISC Handbook. Provide for unusual end loads where necessary. All welding shall be performed with procedures and by operators recently certified in accordance with the standards of the American Welding Society. Connections shall be types shown on the drawings and/or specified. No burning of holes for connections will be allowed. Field holes shall be drilled. Punch, sub-punch and ream, or drill bolt holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

B. Tightening of Shear/Bearing Connections: ASTM A307 and ASTM A325N bolts, in connections not defined as slip critical or subject to direct tension loads, shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a worker using a spud wrench, contact the Engineer for further instructions. Bolts which may be tightened only to a snug tight condition shall be clearly identified on the drawing.

C. Tightening of Connections Requiring Full Pretensioning: ASTM A325 and A490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

D. Tightening of Foundation Bolts: Unless otherwise directed, anchor bolts shall be set prior to concrete pouring. Do not tighten with an impact torque wrench and/or until concrete has cured minimum of 14 days.

3.03 WELDING

A. AWS D1.1, except use only shielded metal arc welding and low hydrogen electrodes for ASTM A514 steel. Do not stress relieve ASTM A514 steel by heat treatment. Grind exposed welds smooth as indicated. Provide AWS D1.1 qualified welders, welding operators, and tackers.

B. Removal of Temporary Welds, Run-Off Plates, and Backing Strips: Remove only from finished areas.

C. Field welding will not be permitted on primed or painted steel. Contractor is responsible for properly cleaning steel before welding.

3.04 GALVANIZING REPAIR

A. Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.05 FIELD QUALITY CONTROL

A. Perform field tests, and provide labor, equipment, and incidentals required for testing. The Engineer shall be notified in writing of defective welds within 7 working days of the date of weld inspection.

B. Welds:
   1. Furnish the services of AWS-certified welding inspectors for fabrication, erection, testing and verification inspections. Welding inspectors shall inspect and mark welds, including fillet weld end returns. All defective welds that have been repaired shall be retested.
   2. Shop welds required for structural connections shall be visually inspected and approved by an independent testing laboratory. All questionable welds shall be radiographically or ultrasonically tested. If questionable welds prove defective, Contractor shall test minimum 10% or all other welds at no additional cost.
   3. Field welds required for structural connections shall be visually inspected and approved by independent testing laboratory. All questionable welds and at least 10% of all other welds shall be tested by magnetic particle testing or ultrasonic testing.

C. Bolts:

1. Fully Pretensioned Connections: Engineer shall require Contractor to verify bolt tension on a minimum of 10 percent of fasteners. Contractor shall provide and operate bolt tension indicator device.

D. Testing for Embrittlement: ASTM A143 for steel products hot-dip galvanized after fabrication.

END OF SECTION

SECTION 05 31 23

STEEL ROOF DECKING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall provide all labor, materials and equipment required to furnish and install Steel Roof Decking and accessories, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Iron and Steel Institute (AISI) Publication:
   a. SG671 Specification for the Design of Cold-Formed Steel Structural Members
2. American Society for Testing and Materials (ASTM) Publications:
   a. A525 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
   b. A611 Steel, Cold Rolled, Carbon
   c. A653 Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   d. C423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
3. American Welding Society, Inc. (AWS) Publications:
   a. D1.1 Structural Welding Code, Steel
   b. D1.3 Structural Welding Code - Sheet Steel
4. Factory Mutual Engineering and Research Corporation (FM) Publications:
   a. P7825 Approval Guide
   b. D/S1-28 Insulated Steel Deck, Loss Prevention Data Sheet 1-28
5. Steel Deck Institute (SDEI) Publication:
   a. DMCDFDRD Design Manual for Composite Decks, Form Decks and Roof Decks
6. Underwriters Laboratories, Inc. (UL) Publications:
   a. BMD Building Materials Directory
   b. 580 Tests for Uplift Resistance of Roof Assemblies

1.03 SUBMITTALS: Submit the following:

A. Manufacturer's Catalog Data: Submit manufacturer's catalog data for roof deck and accessories. Include decking design properties, allowable loadings and applicable published literature covering the specific type of construction required by this project. Submit and obtain approval before delivery of material to the project site.

B. Drawings: Before starting work, submit completely detailed shop drawings indicating the decking, connections, bearing on supports, methods of anchoring, accessories, attachment of accessories, roof layout, placement directions, size and location of holes to be cut and reinforcement to be provided, type and sequence of welded connections, and other pertinent details.

C. Statements:
1. Welder Certification: Submit qualifications of welders and duration of qualification period in accordance with AWS.

D. Certificates of Compliance:
1. Steel Deck Materials: Submit manufacturer's certification attesting that roof decks meet the requirements of SDI and AISI.

1.04 QUALITY ASSURANCE

A. Steel Deck: Deck and accessories shall be the products of a manufacturer regularly engaged in the manufacture of steel roof decking.

B. Welder Certification: Provide qualification of welders and duration of qualification period in accordance with AWS.

C. Regulatory Requirements:
1. Wind Storm Resistance: The roof construction assembly shall be capable of withstanding an uplift pressure of 20 pounds per square foot when tested in accordance with the uplift pressure test described in the FM D/S1-28 or as described in UL 580.

1.05 DELIVERY AND STORAGE

A. Do not damage or overload decking and accessories during delivery, storage, or handling. Do not use decking for storage or as working platform until units have been welded into position. Stack decking on platforms or pallets, and cover with weathertight ventilated covering. Elevate one end during storage to provide for drainage. Contractor is responsible for replacing damaged material.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel: Deck units shall be manufactured from steel conforming to ASTM A653, Grade A having a minimum yield of strength of 33,000 psi. Quality and properties shall conform to AISI SG671.

B. Shop Painting: Shop paint deck and accessories at the factory by an application of a cleaning treatment in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured.

C. Accessories: Provide accessories of the same material as the deck and not lighter than 20-gauge, unless specified otherwise herein. Provide manufacturer's standard type accessories, as specified herein.

1. Adjusting Plates: Provide plates of the same gauge and configuration as the roof units. Use factory cut plates of predetermined sizes where possible.
2. End Closures: Factory fabricate of minimum 22 gauge sheet metal.
3. Closures Above Partitions: Provide flexible rubber or sheet steel closures above typical partitions.
4. Cover Plates: Provide butt cover plates, underlapping sleeves; or 2-inch wide noncombustible, pressure sensitive tape.
5. Miscellaneous Accessories: Provide cant strips, fasteners, sump pans, ridge and valley plates, and various types of plates and closures as indicated or as necessary to complete the work. Provide accessories required for a finished installation.

2.02 FABRICATION

A. Provide decking in accordance with SDEI DMCDFDRD.

B. Decking shall have the structural properties indicated on drawings. Deck units shall conform to manufacturer's published load tables. Deck shall safely support uniformly distributed live loads as indicated on drawings, plus dead loads of construction indicated and/or specified. Deflection shall not exceed 1/240 of maximum span for live loads specified.

PART 3 - EXECUTION

3.01 INSPECTION OF SUPPORT STRUCTURE

A. Prior to installation of steel roof deck and accessories, inspect the support structure to verify that the as-built structure will permit the indicated field installation of the decking system without modification.

3.02 INSTALLATION

A. Install steel roof deck units in accordance with approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Engineer and make necessary corrections before deck units are anchored permanently in place. Locate end laps over supports only, with minimum lap of 2 inches. Do not use unanchored deck units as a work or storage platform. Permanently anchor units placed by the end of each working day. Suspended ceilings, light fixtures, ducts, utilities, or other loads shall not be supported by the steel deck.

B. Anchorage Methods: After placement and alignment, and after inaccuracies have been corrected, permanently fasten steel roof deck units in place by welding, or with self-drilling screws or powder-actuated fasteners. Use methods as recommended by the Steel Deck Institute, subject to the Engineer's approval. Length of side and end laps of deck and intervals of fastening shall be as recommended by the steel deck manufacturer, but not less than 2 inches. Clamp or weight deck units to provide firm contact between deck units and structural supports while welding or fastening is being performed.
   1. Welding: Perform welding in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturers of the base metal alloys being used. Welds shall be made only by operators previously qualified by test prescribed in AWS to perform the type of work required. Location, size and spacing of welds shall be designed to withstand the loads indicated and in accordance with the Steel Deck Institute recommendations and as shown on the approved shop drawings. Clean welds immediately by chipping and wire brushing. Heavily coat welds, weld scars, cut edges, drill holes, rust spots and damaged portions of shop finish and zinc-rich primer provided by the deck supplier and approved by the Engineer.
   2. Fasteners, Powder Actuated and Screwed: Provide fasteners for anchoring the deck to structural supports and adjoining units that are designed to withstand the design loads indicated and that are standard with the Steel Deck Institute and the manufacturer. Provide fasteners of a positive locking type; approved prior to installation.

C. Accessories: Install cover plates, adjusting plates, finish strips, closures and closure sheets as necessary to complete the work. Install finish strips and closure sheets so as to lap one support a minimum of 2 inches.
   1. Adjusting Plates: Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.
   2. End Closures: Provide end closure to close open ends of cells at eaves.
   3. Closures Above Partitions: Provide for closing voids between cells above interior walls and over partitions that are perpendicular to direction of cells. Provide a one-piece closure strip for partitions 4 inches nominal or

less in width and two-piece closure strips for wider partitions. Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation.

4. Cover Plates: Provide at end joints between adjoining non-lapping units.

D. Openings:

1. Openings required in deck larger than five square feet, or greater than 24 inches in either direction or 30 inches in diameter, shall be predetermined and provided as a part of fabrication herein.
2. Punching, drilling or cutting deck openings smaller than above stated for passage of pipes, ducts, or attachment of other items shall be performed in field by Contractor requiring such. Obtain approval of the Engineer for such holes or other openings larger than 6 inches in diameter.
3. Steel reinforcing members indicated or require around openings through decks for roof hatches, fans, and similar projections, will be provided by others when shown on drawings. If not shown, but required, this Contractor shall provide such.
4. Steel reinforcing members required for auxiliary openings smaller than stated above and not indicated on drawings shall be provided by Contractor requiring opening.

3.03 FIELD QUALITY CONTROL

A. Inspect the decking top surface for flatness after installation. The top flanges of each sheet shall be flat with concavity or convexity not to exceed 1/16-inch (1.58-mm). A straight edge placed across any three contact surfaces shall leave a gap of not more than 1/16-inch between the straight edge and any point of the contact surface; when gap is more than 1/16-inch, provide corrective measures or replacement. Reinspect the decking after performing corrective measures or replacement.

B. Complete installation of deck and accessories shall be subject to approval by roofing Contractor and Engineer.

END OF SECTION

SECTION 05 40 01

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Cold-Formed Metal Framing, as shown on the Plans, as specified, and/or directed.

1.02 APPLICABLE PUBLICATIONS

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Institute of Steel Construction (AISC) Publication:
   a. SG671 Specification for the Design of Cold-Formed Steel Structural Members
2. American Society for Testing and Materials (ASTM) Publications:
   a. A570 Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
   b. A611 Steel, Sheet, Carbon, Cold-Rolled, Structural Quality
   c. A653 Steel Sheet, Zinc Coated (Galvanized) OR Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
3. American Welding Society, Inc. (AWS) Publication:
   a. D1.3 Structural Welding Code Sheet Steel

1.03 SUBMITTALS: Submit the following.

A. Design Data:
   1. Metal framing calculations

   Verify sizes, gauges, and spacing of members and connections. Show methods and practices used in installation.

B. Manufacturer's Catalog Data:
   1. Cold-formed metal framing members

C. Drawings:
   1. Cold-formed metal framing

   Show sizes, thicknesses, layout, material designations, methods of installation, and accessories.

D. Certificates of Compliance:
   1. Cold-formed metal framing members

1.04 DELIVERY AND STORAGE

A. Deliver materials to job site and store in adequately ventilated, dry locations. Storage area shall permit easy access for inspection and handling. If necessary to store materials outside, stack off the ground, properly support on a level platform, and fully protect from the weather as approved. Handle materials carefully to prevent damage. Replace damaged items with new, as directed by the Engineer.

1.05 LOAD-BEARING COLD-FORMED METAL FRAMING

A. Include top and bottom tracks, bracing, fastenings, and other accessories necessary for complete installation. Framing members shall have the structural properties indicated. Where physical structural properties are not indicated, they shall be as necessary to withstand all imposed loads. Design framing in accordance with AISI Specification for the Design of Cold-Formed Steel Structural Members. Design loads shall be in accordance with NAVFAC DM-2.01 and NAVFAC P-355. Nonload-bearing metal framing, furring, and ceiling suspension systems are specified in “Non-Structural Metal Framing." Metal suspension systems for acoustical ceilings are specified in Section titled "Acoustical Tile Ceilings".

1.06 MAXIMUM DEFLECTION

A. Exterior Studs:

Deflection Criteria	Exterior Finish
L/240 or L/360	Synthetic Plaster, Metal Panels
L/360	Cement Plaster, Wood Veneer
L/600	Brick Veneer, Stone Panels

Wall deflections shall be computed on the basis that studs withstand all lateral forces independent of any composite action from sheathing materials. Studs abutting windows or louvers shall also be designed not to exceed 1/4-inch maximum deflection.

B. Floor Joists:

L/360 - Live load only
L/240 - Total load

C. Roof Rafters:

L/240 - Live load only

PART 2 - PRODUCTS

2.01 STUDS AND JOISTS

A. Studs and Joists of 16 Gauge (0.0598 inch) and Heavier Galvanized steel, ASTM A653, Grade D, G60.

B. Studs and Joists of 18 Gauge (0.0478 inch) and Lighter Studs and Joists of 18 Gauge (0.0478 inch) and Lighter, Track, and Accessories (All Gauges): Galvanized steel, ASTM A653, Grade A (33,000 psi) G60.

PART 3 - EXECUTION

3.01 FASTENING

A. Fasten framing members together by welding or by using self-drilling or self-tapping screws. Welding shall conform to AWS D1.3 welding procedure. Electrodes and screw connections shall be as required and indicated in the design calculations. Do not field weld materials lighter than 18 gauge.

3.02 TRACKS

A. Provide accurately aligned runners at top and bottom of partitions. Anchor tracks as indicated in design calculations. Butt weld joints in tracks or splice with stud inserts. Fasteners shall be at least 3 inches from the edge of concrete slabs.

3.03 STUDS

A. Cut studs square and set with firm bearing against webs of top and bottom tracks. Position studs vertically in tracks and space as indicated in design. Do not splice studs. Provide at least two studs at jambs of doors and other openings 2 feet wide or larger. Provide jack studs over openings, as necessary, to maintain indicated stud spacing. Provide tripled studs at corners, positioned to receive interior and exterior finishes. Fasten studs to top and bottom tracks by welding or screwing both flanges to the tracks. In curtain wall construction, provide for vertical movement where studs connect to the structural frame. Provide horizontal bracing in accordance with the design calculations and in AISI SG671, consisting of, as a minimum, runner channel cut to fit between and welded to the studs or hot- or cold-rolled steel channels inserted through cutouts in web of each stud and secured to studs with welded clip angles. Bracing shall be not less than the following:

LOAD	WEIGHT	BRACING

Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

3.04 JOISTS

A. Locate each joist directly above a stud. Provide doubled joists under parallel partitions wherever partition length exceeds 1/2 of joist span. Joists shall have at least 2.50 inches of bearing on steel, 4 inches on masonry, and shall be reinforced over bearings where required to prevent web crippling. Splice joists over bearings only. Lap and weld splices as indicated. Provide manufacturer's standard bridging which shall not be less than the following:

CLEAR SPAN	BRIDGING
Up to 14 feet	One row near center
14 to 20 feet	Two rows at 1/3 points
20 to 26 feet	Three rows at 1/4 points
26 to 32 feet	Four rows at 1/5 points

END OF SECTION

SECTION 05 50 01

METAL FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall provide all labor, materials and equipment required to fabricate and erect all Metal Fabrications, complete with anchorage devices, connections, accessories and incidental work, as shown on the Plans, as specified, and/or directed.

B. No attempt is made to enumerate or describe each item of miscellaneous metal work, but simply to describe major items, certain special items, and general construction requirements for all items.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Aluminum Association, Inc. (AA) Publications:
      a. SAA46 - Standards for Anodized Architectural Aluminum
      b. DAF45 - Designation System for Aluminum Finishes
   2. American Institute of Steel Construction (AISC) Publications:
      a. M011 - Manual of Steel Construction
      b. S326 - Specifications for Structural Steel Buildings
   3. American National Standards Institute, Inc. (ANSI) Publications:
      a. SNT-101 - Safety Requirements for Heavy Duty, Portable, Compressed Air Actuated Fastener Driving Tools
      b. A14.3 - Safety Requirements for Fixed Ladders
      c. B18.2.1 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws
      d. B18.2.4 - Square and Hex Nuts
      e. B18.5 - Round Head Bolts
      f. B18.21.1 - Lock Washers
   4. American Society for Testing and Materials (ASTM) Publications:
      a. A36 - Structural Steel
      b. A48 - Gray Iron Castings
      c. A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
      d. A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
      e. A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware

f. A167 - Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip
g. A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
h. A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
i. A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements
j. A687 - High Strength Non-Headed Steel Bolts and Studs
k. A786 - Rolled Steel Floor Plates
l. B26 - Aluminum-Alloy Sand Castings
m. B108 - Aluminum-Alloy Permanent Mold Castings
n. B209 - Aluminum and Aluminum Alloy Sheet and Plate
o. B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
p. B429 - Aluminum-Alloy Extruded Structural Pipe and Tube

5. American Welding Society, Inc. (AWS) Publication:
   a. D1.1 - Structural Welding Code, Steel
6. National Association of Architectural Metal Manufacturers (NAAMM) Publication:
   a. MFM - Metal Finishes Manual
7. National Fire Protection Association (NFPA) Publication:
   a. 101 - Code for Safety to Life from Fire in Buildings and Structures
8. Steel Structures Painting Council (SSPC) Publications:
   a. SP 2 - Hand Tool Cleaning
   b. SP 3 - Power Tool Cleaning
   c. SP 6 - Commercial Blast Cleaning
   d. Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer

1.03 SUBMITTALS: Submit the following.

A. Manufacturer's Catalog Data:
   1. Access doors and panels
   2. Guard posts
   3. Handrails
   4. Safety nosings and treads
   5. Steel stairs
   6. Structural steel door frames

B. Drawings:
   1. Access doors and panels
   2. Guard posts
   3. Handrails
   4. Miscellaneous plates and shapes
   5. Safety nosings and treads

6. Steel stairs
7. Structural steel door frames

C. Certificates of Compliance: Attest that materials comply with requirements of this Specification and of referenced documents.
1. Carbon steel
2. Steel pipe and tubing
3. Shop primer
4. Welding electrodes and rods

D. Submit drawings for approval prior to fabrication. Include templates, and erection and installation details, indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

E. Design Calculations: Submit calculations reflecting design for equipment platforms and steel stairs. Design calculations and drawings of members (including connections) shall be prepared and sealed by a Registered New York State Professional Engineer, and submitted for approval prior to fabrication.

1.04 QUALIFICATION OF WELDERS

A. In accordance with AWS D1.1 using procedures, materials, and equipment of the type required for the work.

1.05 DELIVERY AND STORAGE

A. Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Contractor shall replace and remove damaged items with new items.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Products shall conform to the respective reference specifications and standards and to the requirements specified herein.

B. Steel and Iron: If not specified otherwise, use standard mill finished structural steel shapes or bar iron in compliance with AISC Specifications for Structural Steel Buildings.

C. Structural Carbon Steel: ASTM A36.

D. Structural Tubing: ASTM A500, Grade B or ASTM A501.

E. Steel Pipe: ASTM A53, Type E or S, Grade B, standard weight unless otherwise specified.

F. Fittings for Steel Pipe: Standard malleable iron fittings.

G. Anchors and Fasteners: Where exposed, shall be of the same material, color, and finish as the metal to which applied.
   1. Expansion Shields: Group, type, class, and style best suited for the purpose. Provide shields recessed not less than 2-1/2 inches into concrete or masonry, unless indicated otherwise.
   2. Lag Screws and Bolts: ANSI B18.2.1, type and grade best suited for the purpose.
   3. Toggle Bolts: ANSI B18.2.1 and ANSI B18.5.
   4. Bolts, Nuts, Studs and Rivets: ANSI B18.2.4 and ASTM A687.
   5. Powder Driven Fasteners: Use when permitted by ANSI. Follow safety provisions of ANSI SNT-101.
   6. Lock Washers: Circular washers shall conform to ANSI B18.21.1. Beveled washers for American Standard beams and channels shall be square or rectangular, taper in thickness, and be smooth.

H. Aluminum Alloy Products: Shall conform to ASTM B209 for sheet plate, ASTM B221 for extrusions and ASTM B26 or ASTM B108 for castings, as applicable. Provide aluminum extrusions at least 1/8-inch thick and aluminum plate or sheet at least 0.050-inch thick.

2.02 DISSIMILAR MATERIALS

A. Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect the surfaces with a coat of bituminous paint, a coat of varnish or a coat of zinc chromate primer to prevent galvanic or corrosive action.

PART 3 - EXECUTION

3.01 FABRICATION

A. By mechanics skilled in the trade and in accordance with the manufacturer's directions. Metal work shall be well formed to shape and size, with sharp lines, angles, and true curves. All work shall be fabricated to allow for expansion and contraction of materials. Provide welding and bracing of adequate strength and durability, with tight, flush joints, dressed smooth and clean.

3.02 MEASUREMENTS

A. Before fabrication, provide necessary field measurements and verify all measurements. Wherever possible, field measurements shall be taken prior to

fabrication. Do not delay job progress; allow for trimming where final dimensions cannot be established before fabrication. The Contractor is solely responsible for fit and shall make all corrections required to items fabricated off site at no additional cost to Owner.

3.03 METAL SURFACES

A. Shall be clean and free from mill scale, flake rust and rust pitting; well formed and finished to shape and size, with sharp lines, angles, and smooth surfaces. Shearing and punching shall leave clean true lines and surfaces. Weld or rivet permanent connections. Welds and flush rivets shall be used and finished flush and smooth on surfaces that will be exposed after installation. Do not use screws or bolts where they can be avoided; when used, heads shall be countersunk, screwed up tight and threads nicked to prevent loosening.

3.04 CONSTRUCTION

A. Thickness of metal and details of assembly and supports shall give ample strength and stiffness for the minimum loads specified or indicated.

3.05 FASTENING

A. Provide the necessary rabbets, lugs, and brackets so that the work can be assembled in a neat and substantial manner. Holes for bolts and screws shall be drilled. Joints exposed to the weather shall be formed to exclude water. Conceal fastenings where possible.

3.06 SHOP FABRICATION

A. Fabrication and assembly shall be done in the shop to the greatest extent possible. Provide holes required for connection of other adjacent or adjoining work.

3.07 MISCELLANEOUS ITEMS: Provide as noted on drawing.

A. Access Doors and Access Panels: Shall be flush type. Fabricate frames for access doors of steel not lighter than 14-gauge with welded joints and anchorage for securing into construction. Provide access doors with a minimum of 14 by 20 inches and of not lighter than 14-gauge steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, turn-screw-operated latch. Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible. Provide exposed metal surface with a baked enamel finish.

B. Corner Guards and Column Wainscots: 3 foot 6-inch height beginning at the floor.

C. Corner Guards and Shields: Jambs and sills of openings and edges of platforms shall be steel shapes and plates anchored in masonry or concrete with welded steel straps or end-weld stud anchors. Form corner guards for use with ceramic-tile finish on walls, of 0.025-inch thick stainless steel conforming to ASTM A167 with polished finish. Extend corner guards 5 feet above the top of cove base or to the top of the wainscot, whichever is less, and anchor with adjustable anchors of 16-gauge expanded metal.

D. Guard Posts: Provide 8-inch galvanized standard weight steel pipe as specified in ASTM A53. Anchor posts in concrete and fill solidly with minimum 2500 psi concrete conforming to Section 03 30 00, "Cast-in-Place Concrete".

E. Handrails and Railings:

1. Steel Rails, Including Carbon Steel Inserts: Steel rails, including inserts in concrete, shall be steel pipe conforming to ASTM A53 or structural tubing conforming to ASTM A500, Grade B. Steel rails shall be 1-1/2-inch nominal size, Schedule 40. Steel railings shall be hot-dip galvanized and shop painted.
   a. Fabrication: Jointing of posts, rail, and corners shall be by one of the following methods:
      1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8-inch hexagonal-recessed-head setscrews.
      2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.
      3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.
   b. Installation: Shall be masonry with expansion shields and bolts or toggle bolts.
   c. Removable Sections: Shall be as indicated.
2. Aluminum Railings: Shall consist of 1-1/2-inch nominal Schedule 40 pipe conforming to ASTM B429. Railings shall be mill finish aluminum pipe.
   a. Fabrication: Jointing shall be one of the following methods:
      1) Flush-type rail fittings, welded and ground smooth with splice locks secured with 3/8-inch CRS or cadmium plated plain cup point or reverse knurled cup pointed hexagonal recessed head setscrews.
      2) Mitered and welded joints made by fitting post to top rail, intermediate rail to post, mitering corners, groove welding joints and grinding smooth. Railing splices, where allowed, shall be butted and reinforced by a tight fitting dowel or sleeve not less than 6 inches in length. Dowel or

sleeve shall be tack welded or epoxy cemented to one side of the splice.

b. Installation: Shall be affixed to base structure by placing in holes cored in concrete and filled with quick setting anchoring cement flanges anchored to masonry by expansion shields, baseplates or flanges bolted to stringers or structural steel framework. Bolts used to anchor aluminum alloy flanges shall be corrosion resisting steel of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or Portland cement concrete, the contact surface shall be given a heavy coating of bituminous paint or asphaltic varnish.

c. Removable Railing Sections: Shall be as indicated on the drawings.

F. Insect Screen: Bronze or aluminum color, 18-by 18-mesh.

G. Miscellaneous Plates and Shapes: ASTM A36. Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, support framing for ceiling-mounted toilet partitions, miscellaneous mountings and frames.

1. Built-Up Lintels: Bolt together with separators if required. End bearings shall be not less than one inch per foot of span; with maximum bearing 8 inches and minimum bearing 4-1/2 inches. Set lintel with clearance of 1/2 inch above head of buck or frame.
2. Loose Lintels: Provide over openings in masonry walls and partitions as required to support wall loads over openings. Provide with necessary connections and fasteners. Construct to have at least 8 inches bearing on masonry at each end.
3. Angle Lintels: Provide masonry furring with not less than 1/4-inch by width and depth of leg 1/2 inch greater than thickness of furring. For clear spans exceeding 5 feet, support lintels by intermediate wall anchors spaced at intervals of not more than 4 feet.

H. Partitions, Diamond-Mesh Type: Construct partitions of 10-gage steel-wire panels, woven into 1-1/2-inch diamond-mesh with wire secured through one by 1/2 by 1/8-inch weaving channels attached to cold-rolled steel framing members or expanded-metal panels of 1-1/2-inch No. 10, 0.79 pounds per square foot, diamond-mesh secured to one by 1/2 by 1/8-inch channel frame by welding, and attached to cold-rolled steel framing members. The mesh is also to be used for conveyor guarding and for vertical walls of plastics bins. Fully enclose sides of conveyors located so that any person can come in close proximity thereto. Mortise and tenon channel frames at intersections. Steel frames, posts, and intermediate members shall be of the sizes and shapes indicated. Set posts in cast iron floor shoes bolted to the floor and in caps tap-screwed to slip angles in overhead construction. Shoes and caps shall have setscrew adjustment. Provide

doors as indicated, complete with hardware and accessories including sliding mechanisms, locks, guard plates, sill shelves and brackets, and fixed pin butts. Locks shall be bronze; cylinder shall be mortise type. Keying shall be coordinated with Section 08 71 00, "Door Hardware". Metal partitions and accessories shall be galvanized.

I. Safety Chains and Guard Rails: Construct safety chains of galvanized wrought iron, straight link type, 3/16-inch diameter, with at least twelve links per foot, and with snap hooks on each end. Snap hooks shall be boat type and eye bolts for attachment of chains shall be galvanized 3/8-inch bolt with 3/4-inch eye diameter, anchored as indicated. Two chains, 4 inches longer than the anchorage spacing, shall be supplied for each guarded area. Locate guard rails where indicated. Mount the top chain or rail 3 feet 6 inches above the floor, and mount the lower chain or rail 2 feet above the floor.

J. Safety Nosings: Shall be of cast aluminum with plain abrasive-surfaces. Provide nosing at least 4 inches wide and 1/4-inch thick and terminating at not more than 6 inches from the ends of treads for stairs and for platforms and landings. Provide safety nosings with anchors embedded in the concrete and with tops flush with the top of the traffic surface.

K. Safety Treads: Match grating size and type, and provide checkered plate nosing at each tread.

L. Sleeves: Fit pipes passing through concrete or masonry construction with pipe sleeves. Extend each sleeve through its respective wall and cut flush with each surface. Provide sleeves at least one inch greater in diameter than the pipe passing through them. Caulk sleeve and pipe after the piping is installed and tested. Reference Specification Section 07 92 00, "Sealants".

M. Steel Stairs: Provide steel stairs complete with structural or formed channel stringers, steel-plate treads and risers, landings, columns, handrails, and necessary bolts and other fastenings. Steel stairs and accessories shall be hot-dip galvanized.
   1. Design Loads: Design stairs to safely sustain a live load of not less than 100 pounds per square foot, except that stair landings shall be designed to sustain a minimum live load of 150 pounds per square foot.
   2. Materials: Steel stairs shall be of structural steel reinforced properly and in a manner to provide rigid construction, and shall be of welded construction except that rivets or bolts may be used where welding is not practicable; screw or screw-type connections are not permitted.
      a. Structural Steel: Shall conform to ASTM A36.
      b. Steel floor plate shall be supported on angle cleats welded to stringers. Sheet-steel landings shall have angle stiffeners welded on. Stringers shall be continued around and shall have an angle welded on to support the steel landings. Exposed ends shall be closed.

3. Installation: Provide anchor bolts, grating fasteners, washers, and all parts or devices necessary for proper installation. Use lock washers under nuts.
4. Outside Stairs: Shall conform to NFPA 101; fabricate of steel shapes with treads, platforms, and railings as specified herein for steel stairs, and provide complete with required fastenings and accessories. Galvanize and Shop paint outside stairs and accessories.

N. Structural Steel Door Frames:
1. Frames: For slide-up overhead doors, power operated service doors, freight elevator hoistway entrances. Provide frames as shown on the drawings and where not otherwise shown shall be of structural shape or shape and plate composite to provide a full depth channel shape surrounded with at least 1-1/2-inch outstanding legs. For single swing doors, provide continuous 5/8-inch by 1-1/2-inch bar stock stops at head and jambs.
2. Jamb Members: Where track, guides, hoods, hangers, operators, and other such accessories are required, extend the trim legs of jamb members above the opening head to the height and with the anchorage necessary for their support.
3. Built-up Members: Plug weld or flush riveted 10 inches on center. Cut, drill, and tap frames for attachment of hardware from template or approved hardware samples.
4. Jamb Anchors: Provide near top, bottom, and at not more than 24-inch intervals. Provide the bottom of each jamb member with a clip angle welded in place with two 1/2-inch diameter floor bolts for adjustment.

3.08 ANCHORAGE, FASTENINGS, AND CONNECTIONS

A. Anchorage: Provide anchorage for fastening work securely in place. Set anchors in concrete as the work progresses and space not more than 2 feet on centers unless indicated otherwise. Sizes, kinds, and spacings of anchors not indicated or specified shall be as necessary for the purpose, as approved. Anchorage not otherwise specified or indicated includes slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Provide inserts of suitable and approved types where required for support or anchorage of equipment and finish construction. Inserts shall be gray or malleable iron castings or galvanized steel unless indicated or specified otherwise. Slotted inserts shall be of types required to engage with anchors. Except where specified otherwise, anchors and anchor bolts in exterior walls shall be zinc-coated, and all other anchors and anchor bolts shall be heavily coated with bituminous paint.
1. Fastenings: Do not use wood plugs in any material. Use nonferrous attachments for nonferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, and harmonizing with the material to which fastenings are applied. Conceal fastenings where

practicable. Drill and punch to produce clean true lines and surfaces. Countersink metal work to receive hardware.

2. Threaded Connections: Make threaded connections up tight so that threads are entirely concealed. Make bolted work up tight and nick the threads or bush the stem to prevent loosening. Rivet, bolt, and screw heads shall be flat and countersunk in exposed work and elsewhere as required.
3. Anchors and Connecting Members: Provide in concrete or masonry as the work progresses, to avoid unnecessary cutting and drilling. Cut, fit, and drill as necessary so all materials are properly set in place and to permit engaging work to be properly installed.
4. Design Connections: Where not shown or indicated, connection details shall be in accordance with AISC M011, and connections shall be provided using A-307 or A-325 steel bolts. Provide necessary holes for securing work to building. Use lock washers under nuts.
5. Built-In Work: Metal work built-in with concrete or masonry shall be formed for anchorage, or be provided with suitable anchoring devices as shown or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.09 WELDING

A. Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1. Weld in a manner to prevent permanent distortion of the connected parts. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation.

3.10 FINISHES

A. Galvanizing: Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123, ASTM A153 and ASTM A525, as applicable.
   1. Galvanize: Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.
   2. Repair of Zinc-Coated Surfaces: Repair surfaces damaged by welding or other means with galvanizing repair paint or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved. Clean areas to be repaired, and remove the slag from the welds. Surfaces to which stick or paste material is applied, shall be heated with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

B. Shop Cleaning and Painting: After surface preparation, apply pretreatment and primer as specified. Do not coat surfaces of items to be embedded in concrete or to be welded. Recoat damaged surfaces using surface preparation, treatment,

primer and paint that was applied to the adjacent surfaces upon completion of work. Do not apply bituminous protective coatings to items to be finish painted.

1. Environmental Conditions: Do not clean or paint surface when damp or exposed to foggy or rainy weather, when the metallic surfaces temperature is within 5 degrees F of the dew point of the surrounding air, or when the surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Engineer.
2. Surface Preparation: Unless otherwise specified herein, abrasive blast clean exposed surfaces in accordance with SSPC SP 6. Surfaces that will be in spaces above ceiling, attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 2 or SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip-critical joints, but coat them with an approved rust preventive, applied in the shop. Remove such coating just prior to field erection using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.
3. Pretreatment, Priming and Painting: Apply pretreatment, primer, and paint in accordance with the manufacturer's standard practice. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 0.1 mil. Tint the additional prime coat with a small amount of tinting pigment. Structural steel shall be shop primed with one coat SSPC Paint 25. Finish coat of paint is specified in Section 09 91 00, "Painting".

C. Nonferrous Metal Surfaces: Protect by plating, anodic, organic, or other coatings as specified.

D. Aluminum Surfaces:
1. Surface Condition: Before finishes are applied, exposed aluminum sheets, plates, and extrusions shall be free of roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and any other defects which will affect uniform appearance of finished surfaces.

2. Aluminum: Unexposed sheet, plate and extrusions may have mill finish as fabricated. Castings shall have sandblast finish, medium, equal to NAAMM MFM, Metal Finishes Manual, Designation AA-M43 or AA SAA46, Standards for Anodized Architectural Aluminum and AA DAF45 Designation System for Aluminum Finishes of The Aluminum Association Publications.

END OF SECTION

SECTION 05 52 13

PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Steel pipe and tube railings.

1.03 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 anchorages for railings. 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.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Railing brackets.
   3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the licensed structural engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.08 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a licensed Structural Engineer to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft (0.093 sq. m).
      b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg. F (67 deg. C), ambient; 180 deg. F (100 deg. C), material surfaces.

2.02 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
   1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.03 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
   1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.04 FASTENERS

A. General: Provide the following:
   1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
   2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
   2. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

F. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

I. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.06 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   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 flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form Changes in Direction as Follows:
   1. As detailed.
   2. By bending or by inserting prefabricated elbow fittings.
   3. By flush bends or by inserting prefabricated flush-elbow fittings.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure..

Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.07 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

E. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime- coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
   1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.02 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
   1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
   3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
   1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.03 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.04 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.

D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.05 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger o lag bolts.

3.06 ADJUSTING AND CLEANING

A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.07 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective overings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 05 72 30

ALUMINUM RAILINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall provide all labor, materials and equipment required to fabricate and erect all Aluminum Railings, complete with anchorage devices, connections, accessories and incidental work, as shown on the Plans, as specified, and/or directed.

B. No attempt is made to enumerate or describe each item of miscellaneous metal work, but simply to describe major items, certain special items, and general construction requirements for all items.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. Aluminum Association, Inc. (AA) Publications:
   a. SAA46 Standards for Anodized Architectural Aluminum
   b. DAF45 Designation System for Aluminum Finishes
2. American Society for Testing and Materials (ASTM) Publications:
   a. B221 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
   b. B429 Aluminum-Alloy Extruded Structural Pipe and Tube
3. National Association of Architectural Metal Manufacturers (NAAMM) Publication:
   a. MFM Metal Finishes Manual

1.03 SUBMITTALS

A. Shop Drawings and Catalog Cuts: Show all railing and guardrail components, details of railing and accessories. These drawings or cuts shall be accompanied by a layout drawing showing spacing of posts, end and pull posts. Drawing shall also show railing and guardrail height.

B. Manufacturer's Catalog Data:
1. Aluminum railing and guardrail

C. Drawings:
   1. Railing and guardrail

D. Submit drawings for approval prior to fabrication. Include templates, and erection and installation details, indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

1.04 DELIVERY AND STORAGE

A. Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Contractor shall replace and remove damaged items with new items.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Products shall conform to the respective reference specifications and standards and to the requirements specified herein.

B. Aluminum Alloy Products: Shall conform to ASTM B221 for extrusions. Provide aluminum extrusions at least 1/8-inch thick.

C. Materials shall conform to the requirements specified:
   1. Wrought Aluminum
   2. Stainless Steel Connecting Products

D. The horizontal rails shall be extruded from 6061-T6 alloy. Pickets and posts shall be extruded from 6061-T6 alloy with a minimum ultimate strength of 45,000 pounds per square inch and a minimum yield strength of 40,000 pounds per square inch. All railing material shall be of uniform quality and condition, free from cracks, blowholes, porous places, hard spots, and shrinkage defects.

E. Fasteners used in assembly of the railing shall be stainless steel with zinc dichromate coating for enhanced corrosion resistance. All fasteners shall have vandal- proof heads and painted to match the finish of the railing.

2.02 DISSIMILAR MATERIALS

A. Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect the surfaces with a coat of bituminous paint, to prevent galvanic or corrosive action.

PART 3 - EXECUTION

3.01 FABRICATION

A. By mechanics skilled in the trade and in accordance with the manufacturer's directions. Metal work shall be well formed to shape and size, with sharp lines, angles, and true curves. All work shall be fabricated to allow for expansion and contraction of materials. Provide welding and bracing of adequate strength and durability, with tight, flush joints, dressed smooth and clean.

3.02 MEASUREMENTS

A. Before fabrication, provide necessary field measurements and verify all measurements. Wherever possible, field measurements shall be taken prior to fabrication. Do not delay job progress; allow for trimming where final dimensions cannot be established before fabrication. The Contractor is solely responsible for fit and shall make all corrections required to items fabricated off site at no additional cost to Owner.

3.03 METAL SURFACES

A. Shall be clean and free from mill scale, flake rust and rust pitting; well formed and finished to shape and size, with sharp lines, angles, and smooth surfaces. Shearing and punching shall leave clean true lines and surfaces. Weld or rivet permanent connections. Welds and flush rivets shall be used and finished flush and smooth on surfaces that will be exposed after installation. Do not use screws or bolts where they can be avoided; when used, heads shall be countersunk, screwed up tight and threads nicked to prevent loosening.

3.04 CONSTRUCTION

A. Thickness of metal and details of assembly and supports shall give ample strength and stiffness for the minimum loads specified or indicated.

3.05 FASTENING

A. Provide the necessary rabbets, lugs, and brackets so that the work can be assembled in a neat and substantial manner. Holes for bolts and screws shall be drilled. Joints exposed to the weather shall be formed to exclude water. Conceal fastenings where possible.

3.06 SHOP FABRICATION

A. Fabrication and assembly shall be done in the shop to the greatest extent possible. Provide holes required for connection of other adjacent or adjoining work.

3.07 ALUMINUM RAILINGS

A. Assembly of the railing components shall be performed in strict accordance with manufacturer's recommendations for installation. All work shall be free of blemishes or defects which can affect durability, strength or appearance.

B. The aluminum railings shall be assembled and installed true to line and grade with the posts vertical as shown on the Plans or as directed by the Engineer.

C. All posts shall be set plumb.

D. The Contractor shall protect all parts to the railing and maintain it in an undamaged condition until completion and acceptance of the Contract. Any sections damaged at any time prior to final acceptance shall be repaired or replaced at the Contractor's expense.

3.08 MISCELLANEOUS ITEMS: Provide as noted on drawing.

A. Aluminum Railings & Guardrails:
   1. Aluminum Railings & Guardrails:
      a. Fabrication: Jointing shall be one of the following methods:
         1) Mitered and welded joints made by fitting post to top rail, intermediate rails to post, mitering corners, groove welding joints and grinding smooth. Railing splices, where allowed, shall be butted and reinforced by a tight fitting dowel or sleeve not less than 6 inches in length. Dowel or sleeve shall be tack welded or epoxy cemented to one side of the splice.
         2) Installation: Shall be affixed to base structure by placing in holes cored in concrete and filled with quick setting anchoring cement. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or Portland cement concrete, the contact surface shall be given a heavy coating of bituminous paint or asphaltic varnish.

3.09 FINISHES

A. Aluminum Surfaces:
   1. Surface Condition: Before finishes are applied, exposed aluminum extrusions shall be free of roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and any other defects which will affect uniform appearance of finished surfaces.
   2. Finish: Class I, Clear Anodic Finish: AA-M12C22A42/A44 Anodic Coating: Architectural Class I, 0.7 mil (0.018 mm) or thicker, complying with AAMA 606.1 or AAMA 608.1.

3.10 FIELD QUALITY CONTROL

A. Complete installation of Aluminum Railings shall be subject to approval by Engineer.

END OF SECTION

SECTION 06 10 01

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall provide all labor, materials and equipment required to furnish and install Rough Carpentry, as shown on the Plans, as specified, and/or as directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Institute of Timber Construction (AITC) Publication:
      a. A190.1 - Structural Glued Laminated Timber (ANSI/AITC A190.1)
   2. American National Standards Institute, Inc. (ANSI) Publications:
      a. B18.2.1 - Square and Hex Bolts and Screws, Inch Series Including Hex Cap Screws and Lag Screws
      b. B18.2.4 - Square and Hex Nuts
      c. B18.5 - Round Head Bolts (Inch Series)
      d. B18.6.1 - Wood Screws (Inch Series)
   3. American Plywood Association (APA) Publications:
      a. E30-F - APA Design/Construction Guide, Residential and Commercial
      b. E445-J - Performance Standards and Policies for APA Structural-Use Panels (APA PRP-108)
   4. American Society for Testing and Materials (ASTM) Publications:
      a. A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements for
      b. A687 - High-Strength Non-headed Steel Bolts and Studs
      c. C79 - Gypsum Sheathing Board
      d. C208 - Insulating Board (Cellulosic Fiber), Structural and Decorative
      e. D2277 - Fiberboard Nail-Base Sheathing
   5. American Wood-Preservers' Association (AWPA) Publications:
      a. C1 - All Timber Products - Preservative Treatment by Pressure Process
      b. C2 - Standard for the Preservative Treatment of Lumber, Timber, Bridge Ties, and Mine Ties by Pressure Treatment
   6. C9 - Plywood - Preservative Treatment by Pressure Process

7. C28 - Structural Glued Laminated Members and Laminations Before Gluing, Pressure Treatment
8. M2 - Standard for Inspection of Treated Timber Products
9. M6 - Brands Used on Forest Products
10. American Wood Preservers Bureau (AWPB) Publication:
    a. LP22 - Standard for Softwood Lumber, Timber, and Plywood Pressure Treated with Waterborne Preservatives for Ground Contact Use
11. Northeastern Lumber Manufacturers Association (NELMA) Publication:
    a. SGRNL - Standard Grading Rules for Northeastern Lumber
12. National Forest Products Association (NFP) Publications:
    a. NDS - National Design Specification for Wood Construction, Design Values for Wood Construction
    b. WCD1 - Manual for House Framing
13. U.S. Department of Commerce Product Standards (PS):
    a. PS-1 - Construction and Industrial Plywood
    b. PS-2 - Performance Standard for Wood-based Structural-use Panels
    c. PS-20 - American Softwood Lumber Standard
    d. PS-56 - Structural Glued Laminated Timber
    e. PS-58 - Basic Hardboard
14. Truss Plate Institute (TPI) Publications:
    a. DSB - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses
    b. TPI 1 - National Design Standards for Metal Plate Connected Wood Truss Construction
    c. BCSI 1 - Guide to Good Practice for Handling, Installing & Bracing of Metal Plate Connected Wood Trusses

1.03 SUBMITTALS: Submit the following.

A. Statements:
   1. Certificates of grade

   Submit certificates attesting that products meet the grade requirements specified in lieu of grade arkings where appearance is important and grade marks will deface material.

B. Factory Test Report:
   1. Treatment standard compliance

   Submit report required in paragraph entitled "Preservative-Treated Lumber and Plywood".

1.04 DELIVERY AND STORAGE

A. Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Remove defective and damaged materials and provide new materials.

1.05 GRADING AND MARKING

A. Lumber: Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.

B. Plywood: Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with PS-1.

C. Preservative-Treated Lumber and Plywood: The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide the Engineer with the inspection report of an independent inspection agency that offered products comply with applicable AWPA Standards. The AWPB LP22 Quality Mark "LP-22"on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

D. Hardboard, Gypsum Board, and Fiberboard: Mark each sheet or bundle to identify the standard under which the material is produced and the producer.

1.06 SIZES AND SURFACING:

A. PS-20 for dressed sizes of yard and structural lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

1.07 MOISTURE CONTENT

A. Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:
   1. Framing lumber and boards - 19 percent maximum
   2. Timbers 5 inches and thicker - 25 percent maximum
   3. Materials other than lumber - Moisture content shall be in accordance with standard under which the product is produced

1.08 FIRE RETARDENT TREATED LUMBER AND PLYWOOD

A. Fire-Retardant Treated Lumber and Plywood: Mark each piece in accordance with Mil. Spec. MIL-L-0019140, except pieces that are to be a natural finish or are to be coated with a transparent finish. Underwriters Laboratories labels will be accepted as evidence of conformance to the fire retardant requirements of Mil. Spec. MIL-L-0019140.Nailers, edge strips, crickets, curbs, and cants for roof decks.

PART 2 - PRODUCTS

2.01 LUMBER

A. Structural Lumber: Except where a specific grade is indicated or specified, any of the species and grades listed in NFP NDS that have allowable unit stresses in pounds per square inch (psi) not less than 1,200 Fb, with 1,200,000 E allowable unit stresses indicated.

B. Framing Lumber: Framing lumber such as studs, plates, caps, collar beams, cant strips, bucks, sleepers, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing shall be one of the species listed in the table below. Minimum grade of species shall be as listed.

Table of Grades for Framing and Board Lumber

Grading Rules	Species	Framing	Board Lumber
NELMA SGRNL Standard Grading Rules	Balsam Fir, Eastern Hemlock - Tamarack, Eastern Spruce, Eastern White Pine, Northern Pine, Northern Pine Cedar	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade For 2 x 4 Size, 10 Feet and Shorter)	All Species: No. 3 Common Except Standard for Eastern White and Northern Pine

2.02 PLYWOOD AND STRUCTURAL-USE PANELS

A. PS-1 and APA E445-J, respectively.

B. Subflooring:
1. Plywood: C-D Grade, Exposure 1 durability classification, Span rating of 24/16 or greater.

2.03 OTHER MATERIALS

A. Hardboard Underlayment: PS-58, service class, sanded on one side, 1/4-inch thick, 4-feet wide.

B. Fiberboard Wall Sheathing: ASTM C208, 2-feet wide by 1/2-inch thick for supports 16 inches (o.c.), 25/32-inch thick for supports 24 inches o.c. or 4-feet wide by 1/2-inch thick for supports 16 inches o.c. except only 4-feet wide by 1/2-inch thick sheathing over supports at 16 inches o.c. may be applied without corner bracing of framing. Sheathing shall be asphalt impregnated or asphalt coated to render the sheathing water resistant but vapor permeable. Fiberboard nail base sheathing conforming to ASTM D2277 may be provided as an option to 1/2-inch thick sheathing conforming to ASTM C208.

C. Gypsum Wall Sheathing: ASTM C79, 1/2-inch thick; 4-feet wide with square edge.

D. Air Infiltration Barrier: Cross laminated polyethylene, UV resistant.

2.04 ROUGH HARDWARE

A. Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be zinc-coated.

B. Bolts, Nuts, Studs, and Rivets: ANSI B18.2.1, ANSI B18.5, ANSI B18.2.2, and ASTM A687. Provide a flat washer under each bolt head and a flat and lock washers under each nut.

C. Lag Screws and Lag Bolts: ANSI B18.2.1.

D. Wood Screws: ANSI B18.6.1.

E. Joist Hangers: Steel or iron, zinc coated, sized to fit the supported member, of sufficient strength to develop the full strength of the supported member, and furnished complete with any special nails required.

F. Joist Anchors: For joists supported by masonry walls, provide anchors 3/16-inch by 1-1/2-inch steel tee or strap, bent and of length to provide 4 inches embedment into wall and 12 inches along joist. For joists parallel to masonry or concrete walls, provide anchors 1/4-inch by 1-1/4-inch minimum cross-sectional area, steel strap, length as necessary to extend over top of first three joists and into wall 4 inches, and with wall end of bend or pin type.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Conform to NFP WCD1 unless otherwise indicated or specified. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Set joists, rafters, and purlins with their crown edge up. Faces of framing members which will receive gypsum wallboard shall not vary more than 1/8 inch from the plane of the faces of adjacent framing, bridging, or furring members. Frame members for the passage of pipes, conduits, and ducts. Do not cut or bore structural members for the passage of ducts or pipes without approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spikes, nails, and bolts shall be drawn up tight.

B. Joists: Provide joists of the sizes and spacing indicated, accurately and in alignment, and of uniform width. Joists shall have full bearing on sills, plates; provide laps over bearing only and spike. Where joists are of insufficient length to produce a 12-inch lap, butt joists over bearing and provide wood scabs 2 inches thick by depth of joists by 24 inches long or metal straps 1/4 inch by 1-1/2 inch by not less than 18 inches long nailed to each joist with not less than four 10-penny nails, or approved sheet metal connectors installed in accordance with the manufacturer's recommendations. Provide joists built into masonry with a beveled fire cut so that the top of the joist does not enter the wall more than one inch. Provide metal hangers for joists framing into the side of headers, beams, or girders. The minimum joist end bearing shall be 4 inches, and joists built into concrete or masonry shall have a 1/2-inch minimum clearance at the top, end, and sides. For joists approved to be bored for the passage of pipes or conduits, bore through the neutral axis of the joist. Provide steel joist hangers of proper size and type to receive the ends of all framed joists.

1. Doubled Joists: Provide under bearing walls and partitions running parallel with the floor joists, around and at other openings where joists are cut and framed. Double, space for clearance, block apart 4 feet on center, rigidly frame, and spike together joists under partitions that are to receive ducts, pipes, and conduits.
2. Joist Anchors: Provide anchors for each fourth joist supported by a masonry wall. Build wall end of anchors into the wall. Nail anchor to the joist with three 10-penny nails spaced 2 inches o.c. Anchor the first three joists parallel to concrete or masonry walls at bridging points, but not less than 8 feet o.c. from end walls. Let anchors into the tops of each joist and spike to the top of joist with one 10-penny nail. Extend anchors at least 4 inches into the wall.

C. Bridging: Provide bridging for floor and ceiling joists and for roof rafters having slopes of less than 4 inches in 12 inches. Locate bridging as indicated and as specified herein. Provide bridging for spans greater than 6 feet, but do not exceed 8-feet maximum spacing between rows of bridging. Install rows of bridging uniformly. Provide metal or wood cross-bridging, except where solid bridging is indicated. Do not nail the bottom end of cross bridging until the subfloor has been laid.

1. Wood Cross Bridging: Provide wood cross bridging not less than 2 by 4 inches. Nail wood cross bridging at each end with two 8-penny nails for one-inch thick material and three 8-penny nails for 2-inch thick material.
2. Metal Cross Bridging: Shall be the manufacturer's standard product, not less than 16 gauge before forming and coating. Metal bridging shall be the compression type, lodged into or nailed to the wide faces of opposite joists at points diagonally across from each other near the bottoms and tops of joists.

D. Subflooring:

1. Plywood and Structural-Use Panels: Apply best side up with the grain of outer plies or the long dimension at right angles to joists. Stagger end joints and locate over the center line of joists. Support panel edges by nominal 2-by 4-inch members framed between joists so the edge joints of subfloor occur over the center line of blocking. Allow 1/8-inch spacing at panel ends and 1/4 inch at panel edges. Panels shall be continuous over two or more spans. Nail panels 6 inches o.c. at supported edges and 10 inches o.c. over intermediate bearing. Nails shall be 8-penny common or 6-penny threaded. Provide at least 1/2-inch clearance between subflooring and masonry or concrete walls.

E. Underlayment: Install underlayment over subfloor just prior to laying of resilient flooring and carpeting and protect from water and physical damage. Underlayment shall be hardboard or plywood. Stagger end joints of underlayment with respect to each other, and stagger all joints with respect to paralleling panel joints in subfloor. Space panels 1/16 inch apart at ends and 1/8 inch apart at edges and at least 1/2 inch from concrete or masonry walls. Nail panels 6 inches o.c. along edges and 6 inches o.c. each way throughout panel, but not closer than 3/8 inch to panel edges. Nails shall be 4-penny annular ring or screw type and shall be countersunk 1/16 inch. Lightly sand all joints to receive resilient flooring or carpeting.

F. Wall Sheathing:

1. Fiberboard Wall Sheathing: Apply fiberboard wall sheathing allowing a 1/8-inch joint at edges to permit expansion, except at frames and openings where sheathing shall be fitted snugly. Pre-expand sheathing before application, allowing sheathing to condition for humidity as recommended by the sheathing manufacturer. Provide 2-by 4-inch blocking for horizontal edges not otherwise supported.

a. Fiberboard wall sheathing used with diagonal-braced framing shall be either 2-feet or 4-feet wide. Sheathing 2-feet wide shall have T&G or shiplapped edges and shall be applied horizontally with vertical joints staggered. Apply sheathing with tongued edge up and nail at edges and intermediate bearings with 1 3/4-inch long, zinc-coated steel roofing nails spaced on maximum 4-1/2-inch centers. Apply sheathing 4-feet wide either horizontally or vertically. Nail sheathing with 1-3/4-inch long, zinc-coated steel roofing nails spaced 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

b. Fiberboard wall sheathing used with unbraced framing shall be 4-feet wide. Apply sheathing vertically. Extend sheathing over and nail to sill and top plates. Locate joints over center lines of supports. Nail sheathing with 1-1/2-inch long, zinc-coated steel roofing nails with 3/8-inch diameter heads. Space nails 3 inches o.c. at edges and ends and 6 inches o.c. at intermediate bearings.

2. Gypsum Sheathing Board: Apply gypsum sheathing board either horizontally or vertically. Butt joints and locate over the center lines of supports. Horizontally applied sheathing shall be T&G, applied with tongued edge up. Stagger vertical joints and abut sheet closely to frames of openings. Nail sheathing with 11 gauge, 3/8-inch head, zinc-coated nails 1-1/2 inches long for 1/2-inch sheathing and 1-3/4 inches long for 5/8-inch sheathing, spaced 3/8 inch minimum from edges. Provide 2-by 4-inch blocking for horizontal edges of 4-foot wide panels not otherwise supported.

a. Gypsum Sheathing Board Used with Diagonal-Braced Framing: Sheathing shall be either 2-feet or 4-feet wide. Apply sheathing 2-feet wide horizontally. Nail 4 inches maximum o.c. at edges and over intermediate bearings. Apply sheathing 4-feet wide either horizontally or vertically. Nail 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

b. Gypsum Sheathing Board Used with Unbraced Frames: Sheathing shall be 4-feet wide and applied vertically. Extend sheathing over and nail to both sill and top plates. Nail 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

G. Stair Framing: Cut carriages to exact shape required to receive treads and risers, with risers of uniform height and treads of uniform width. Provide trimmers, nailers, and blocking as required to support finish materials.

3.02 MISCELLANEOUS

A. Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants: Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

1. Roof Nailing Strips: Provide roof nailing strips for roof decks as specified herein. Apply nailing strips in straight parallel rows in the direction and spacing indicated. Strips shall be surface applied.
    a. Surface-Applied Nailers: Shall be 3 inches wide and of thickness to finish flush with the top of the insulation. Anchor strips securely to the roof deck with powder actuated fastening devices or expansion shields and bolts, spaced not more than 24 inches o.c. On decks with slopes of one inch or more, provide surface applied wood nailers for securing insulation.
2. Roof Edge Strips and Nailers: Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers shall be 6 inches wide and the same thickness as the insulation. Strips shall be grooved for edge venting; install at walls, curbs, and other vertical surfaces with a 1/4-to 1/2-inch air space.
3. Crickets, Cants, and Curbs: Provide wood saddles or crickets, cant strips, and wood nailers bolted to tops of concrete or masonry curbs as indicated, specified, or necessary.

B. Wood Blocking: Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

C. Wood Furring: Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips shall be one inch by 3 inches, continuous, and spaced 16 inches o.c. Erect furring vertically or horizontally as necessary. Nail furring strips to masonry. Do not use wood plugs. Provide furring strips around openings, behind bases, and at angles and corners. Furring shall be plumb, rigid, and level and shall be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required. Form furring for offsets and breaks in walls or ceilings on 1-inch by 4-inch wood strips spaced 16 inches o.c.

D. Wood Sleepers: Run wood sleepers in lengths as long as practicable and stagger end joints in adjacent rows.

END OF SECTION

SECTION 06 20 01

FINISH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Finish Carpentry, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Federal Specifications (Fed. Spec.):
      a. FF-B-588C - Bolt, Toggle: and Expansion Sleeve, & Am 1 Screw
      b. FF-N-105B - Nails, Brads, Staples and Spikes: & Int Am 4 Wire, Cut and Wrought
      c. FF-S-325 - Shield, Expansion; Nail, Expansion; & Int Am 3 and Nail, Drive Screw (Devices, Anchoring, Masonry)
      d. Military Specification (Mil. Spec.):
      e. MIL-L-0019140D - Lumber and Plywood, Fire-Retardant Treated
   2. U. S. Department of Commerce, Product Standards (PS):
      a. 1 - Construction and Industrial Plywood
      b. 20 - American Softwood Lumber Standard
      c. 51 - Hardwood and Decorative Plywood
      d. 58 - Basic Hardboard
   3. American National Standards Institute (ANSI) Publications:
      a. A156.9 - Cabinet Hardware
      b. A208.1 - Mat-Formed Wood Particleboard
      c. B18.2.1 - Square and Hex Bolts and Screws Inch Series
      d. B18.2.2 - Square and Hex Nuts
      e. B18.5 - Round Head Bolts (Inch Series)
      f. B18.6.1 - Wood Screws (Inch Series)
   4. American Society for Testing and Materials (ASTM) Publications:
      a. A687 - High-Strength Nonheaded Steel Bolts and Studs
      b. E84 - Surface Burning Characteristics of Building Materials
      c.
   5. American Wood Preservers' Association (AWPA) Standards:
      a. C1 - All Timber Products - Preservative Treatment by Pressure Processes
      b. C2 - Lumber, Timbers, Bridge Ties and Mine Ties – Preservative - Treatment by Pressure Processes
      c. C9 - Plywood - Preservative Treatment by Pressure Processes

6. M2 Inspection of Treated Timber Products
7. M4 Standard for the Care of Preservative - Treated Wood Products
8. M6 Brands Used on Forest Products

B. American Wood Preservers Bureau (AWPB) Quality Standards:
1. LP 22 Standard for Softwood Lumber, Timber and Plywood Pressure Treated With Waterborne Preservatives

C. National Electrical Manufacturers Association (NEMA) Publication:
1. LD 3 High-Pressure Decorative Laminates

D. National Hardwood Lumber Association (NHLA) Publication:
1. Rules for the Measurement and Inspection of Hardwood and Cypress Lumber

E. National Woodwork Manufacturers Association, Inc. (NWMA) Industry Standard:
1. I.S.4 Water Repellent Preservative Non-Pressure Treatment for Millwork

F. Northeastern Lumber Manufacturers Association, Inc. (NELMA) Publication:
1. Standard Grading Rules for
2. Northeastern Lumber

G. Northern Hardwood and Pine Manufacturers Association, Inc. (NHPMA) Publication:
1. Standard Grading Rules for Northern and Eastern Lumber

1.03 SUBMITTALS

A. Shop Drawings: Show all prefabricated millwork. Include details and erection data associated with the work of other trades; materials and species; arrangements; profiles of moldings; thicknesses; sizes of parts; construction; fastenings; and clearances.

B. Certificates of Grade: Submit certificates from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

C. Samples:
1. Interior trim and moldings: One linear foot of each kind.
2. Laminated Plastic: Two samples of each color, pattern, and texture for approval by the Engineer.

1.04 DELIVERY AND STORAGE

A. Deliver lumber, plywood, trim, and millwork to the job site in an undamaged condition. Stack materials to ensure ventilation and drainage and protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in the building until wet trade materials are dry.

1.05 GRADE AND QUALITY MARKING

A. Lumber: Each piece or each bundle of lumber, millwork, and trim shall be identified by the grade mark of a recognized association or independent inspection agency that is certified by the Board of Review, American Lumber Standards Committee, to grade the species.

B. Plywood: Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, and shall show exposure durability classification, grade, and compliance with PS 1.

C. Hardboard and Particleboard: Materials shall bear a marking or statement identifying the producer and the applicable standard.

D. Pressure-Treated Lumber and Plywood: The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be permanently marked or branded, by the producer, in accordance with AWPA M6 (except when lumber is less than 2 inches by 4 inches in size or less than 36 inches in length, and bundled, then only exterior faces must be marked). The Contractor shall provide the Engineer with the inspection report of an independent inspection agency that offered products comply with applicable AWPA Standards. The AWPB Quality Mark "LP-22" on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

E. Nonpressure-Treated Woodwork and Millwork: Mark, stamp, or label, indicating compliance with NWMA I.S.4.

F. Fire-Retardant Treated Lumber and Plywood: Mark each piece in accordance with Mil. Spec. MIL-L-0019140, except pieces that are to be a natural finish or are to be coated with a transparent finish. Underwriters Laboratories labels will be accepted as evidence of conformance to the fire retardance requirements of Mil. Spec. MIL-L-0019140.

1.06 SIZES AND PATTERNS OF WOOD PRODUCTS

A. Yard and board lumber sizes shall conform to PS 20. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the applicable standard.

1.07 MOISTURE CONTENT OF WOOD PRODUCTS

A. Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. The maximum moisture content of wood products at time of delivery to the job site shall be as follows:
   1. Interior paneling: 12 percent.
   2. Interior finish lumber, trim, and millwork 1-1/4 inch or less in nominal thickness: 12 percent on 85 percent of the pieces and 15 percent on remainder.
   3. Exterior treated or untreated finish lumber and trim 4-inch or less in nominal thickness: 15 percent.
   4. Moisture content of other materials shall be in accordance with the applicable standards.

1.08 PRESERVATIVE TREATMENT OF WOOD PRODUCTS

A. Nonpressure Treatment: Treat woodwork and millwork, such as exterior trim, door trim, and window trim, in accordance with NWMA I.S.4, with either 2 percent copper napthenate, 3 percent zinc napthenate, or 1.8 percent copper-8-quinolinolate. Provide a liberal brush coat of preservative treatment to field cuts and holes.

B. Pressure Treatment: Lumber treated in accordance with AWPA C1 and C2, and plywood in accordance with AWPA C1 and C9 shall be used on the exterior of buildings and wood members in contact with masonry or concrete. Treatment shall be verified by an approved inspection agency report, or the AWPB Quality Mark "LP-22" on each piece.

1.09 FIRE-RETARDANT TREATMENT

A. Wood Products: Treat the following items in accordance with Mil. Spec. MIL-L-0019140:
   1. Platforms and Ramps wood structures – Plywood Subfloor and wood sleepers/joists.

B. Plywood: Treat plywood to obtain a flame spread rating of 25 or less and a smoke developed rating of 0-450 or less when tested in accordance with ASTM E84. Fire-retardant treated plywood shall be provided in the following locations:
   1. Platforms and Ramps – Plywood Subfloor.

PART 2 - PRODUCTS

2.01 WOOD

A. Trim, Finish, and Frames: Provide species and grades listed in Table 1 for materials to be paint finished. Materials that are to be stain, natural, or transparent finished shall be one grade higher than that listed. Provide species indicated on drawings for materials to be transparent finished. Run trim, except window stools and aprons, with hollow backs.

Table 1. Grades for Wood to Receive Paint Finish

Grading Rules	Species	Exterior and Interior Trim, Finish, and Frames
NELMA Standard Grading Rules	Balsam Fir, Eastern Hemlock - Tamarack, Eastern Spruce, Eastern White Pine, Norway, Pine, Northern Pine, Northern White Cedar	All Species: C - Select Except C & Btr for Eastern White Pine and Norway Pine
NHPMA Standard Grading Rules	Aspen, Balsam Fir, Eastern Hemlock - Tamarack, Eastern Spruce, Eastern White Pine, Northern Pine	All Species: C & BTR Select

B. Shelving: Suitable species of grade equal to or exceeding Boards, 3 Common Hem-Fir under WWPA Standard Grading Rules for Western Lumber.

C. Softwood Plywood: PS 1, thicknesses as indicated.
1. Plywood for Shelving: Interior Type, A-B Grade, any species group.
2. Plywood for Countertops: Exterior Type, A-C Grade.

2.02 LAMINATED PLASTIC: NEMA LD 3.

A. Countertops: Grade GP 50 or PF 42, Satin Finish. Color and pattern shall be as indicated by Owner.

B. Backing Sheet: BK 20.

2.03 HARDWARE

A. Provide sizes, types, and spacings of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified. Provide hot-dipped galvanized steel or aluminum nails and fastenings where used on the exterior or exposed to the weather.

B. Expansion Shields: Fed. Spec. FF-S-325. Except as shown otherwise, maximum size of devices in Groups IV, V, VI, and VIII shall be 3/8 inch.

C. Toggle Bolts: Fed. Spec. FF-B-588.

D. Wood Screws: ANSI B18.6.1.

E. Wire Nails and Staples: Fed. Spec. FF-N-105.

F. Bolts, Nuts, Lag Screws, and Studs: ANSI B18.2.1, ANSI B18.5, ANSI B18.2.2, and ASTM A687.

G. Closet Hanger Rods: Chromium-plated steel rods, not less than one inch diameter by 18 gauge. Rods may be adjustable with integral mounting brackets if smaller tube is one inch by 18 gauge. Provide intermediate support bracket for all rods more than 48 inches long.

2.04 FABRICATION

A. Countertops: Fabricate with lumber and a core of exterior plywood or particleboard, glued and screwed to form an integral unit. Bond laminated plastic under pressure to exposed surfaces, using type of glue recommended by the plastic manufacturer, and bond a backing sheet under pressure to the underside of the countertop. The countertop unit shall be either the self-edged type covered with NEMA LD 3, Grade GP 50 plastic, or the post-formed type covered with NEMA LD 3, Grade PF 42 plastic, at the option of the Contractor.

B. Cabinets: Fabricate with solid ends and frame fronts, or with frames all around. Frames shall be solid hardwood and, where exposed, of the same species as the plywood veneer. Ends, bottom, back, partitions, and doors shall be hardwood plywood. Mortise and tenon, glue and screw joints to produce a rigid unit, and cover exposed edges of plywood with hardwood strips. Doors, frames, and solid exposed ends shall be 3/4 inch thick; bottom, partitions, and framed ends 1/2 inch minimum; back 1/4 inch minimum.

1. Cabinet Hardware: ANSI A156.9. Provide hardware for each door, including two semi-concealed hinges, and door pull. Provide two side-mounted metal drawer slides and a pull for each drawer. Hardware exposed to view shall be same finish as specified in Section 08 71 00, "Door Hardware".
2. Finish: Provide a natural factory finish on all wood surfaces after fabrication. The finish shall be the fabricator's standard natural finish, except that it shall be equivalent to one coat of sealer and one coat of spar varnish on all surfaces and a second coat of spar varnish on all surfaces exposed to view. Sand lightly and wipe clean between coats.

PART 3 - EXECUTION

3.01 GENERAL FINISH WORK

A. Provide sizes, materials, and designs as indicated and as specified. Apply primer to finish work before installing. Where practicable, shop assemble and finish items of built-up millwork. Joints shall be tight and constructed in a manner that will conceal shrinkage. Miter trim and moldings at exterior angles and cope at interior angles and at returns. Material shall show no warp after installation. Install millwork and trim in the maximum practical lengths. Fasten finish work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping.

B. Exterior Finish Work: Machine-sand exposed flat members and square edges. Machine-finish semi-exposed surfaces. Construct joints to exclude water. In addition to nailing, glue joints of built-up items with waterproof glue as necessary for weather-resistant construction. Provide well distributed end joints in built-up members. Provide shoulder joints in flat work. Hold backs of wide-faced miters together with metal rings and waterproof glue. Fascias and other flat members, unless otherwise indicated, shall be 3/4 inch thick. Provide door and window trim in single lengths. Provide braced, blocked, and rigidly anchored cornices for support and protection of vertical joints. Install soffits in largest practical size. Joints of plywood shall occur over the center lines of supports. Fasten soffits with aluminum or stainless steel nails.

C. Interior Finish Work: After installation, sand exposed surfaces smooth. Provide window and door trim in single lengths.

D. Door Frames: Set plumb and square. Provide solid blocking at not more than 16 inches on centers for each jamb. Position blocking to occur behind hinges and lock strikes. Double wedge frames and fasten with finishing nails. Set nails for putty stopping.

E. Thresholds: Provide thresholds shaped as indicated and cut to fit at jambs. Fasten thresholds with casing nails. Set nails for putty stopping.

F. Window Stools and Aprons: Provide stools with rabbet over the window sill. Provide aprons with returns cut accurately to the profile of the member.

G. Bases: Flat member with a molded top and oak shoe mold. Fasten base to framing or to grounds. Nail shoe mold to the base. Set one-piece wood base after finish flooring is in place.

3.02 SHELVING

A. Nominally one inch thick wood shelf material or 3/4-inch or 23/32-inch thick plywood shelf material supported substantially with end and intermediate supports and arranged to prevent buckling and sagging. Hook strips shall be nominally 1 inch by 4 inches and cleats nominally 1 inch by 2 inches. Use cleats except where hook strips are specified or indicated. Anchor standards to wall at not more than 2 feet on center.

B. Linen Closets: Unless indicated otherwise, linen closets shall have a counter shelf 20 inches wide located about 36 inches above the floor, two lower intermediate shelves, and one bottom shelf approximately 18 inches wide, and upper shelves 11-1/2 inches wide. Locate the bottom shelf immediately above the wood base, and space the upper shelves 14 inches apart and extend to the ceiling.

C. Storage Rooms: Provide storage rooms with shelves 11-1/2 inches wide and spaced 18 inches apart from the floor to the ceiling.

D. Room Closets: Provide two shelves 11-1/2 inches wide. Support the lower shelf by hook strips at the back and ends, and provide full-length metal clothes rods unless indicated otherwise.

E. Janitor Closets: Provide two shelves 14 inches wide.

3.03 CLOTHES HANGER RODS

A. Provide clothes hanger rods where indicated and in closets having hook strips. Set rods parallel with the front edges of the shelves, and support by suitable sockets at each end and by intermediate brackets spaced at not more than 4 foot centers.

3.04 MISCELLANEOUS

A. Counters: Construct as indicated. Conceal fastenings where practicable, fit the counter neatly, install in a rigid and substantial manner, and scribe to adjoining surfaces. Provide counter sections in the longest lengths practicable; keep joints in tops to a minimum; and where joints are necessary, provide tight hairline joints drawn up with concealed-type heavy pull-up bolts. Glue joints with water-resistant glue and, in addition, make rigid and substantial with screws, bolts, or other approved fastenings.

B. Cabinets: Install level, plumb, and tight against adjacent walls. Secure cabinets to walls with concealed toggle bolts, and secure top to cabinet with concealed screws. Make cut-outs for fixtures to templates supplied by fixture manufacturer. Carefully locate cut-outs for pipes so that edges of holes will be covered by escutcheons.

END OF SECTION

SECTION 06 40 00

ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Architectural Woodwork, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications identified herein and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program.
   2. (Fifth Edition) of the Architectural Woodwork Institute (AWI) except as otherwise specified herein. References to "Premium", "Custom", and "Economy" Grades herein, shall be as defined in that Standard.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Metal Framing and Gypsum Board: Sections 05 40 01 and 09 21 16.
   1. Section 06 10 01, “Rough Carpentry”
   2. Section 06 61 16, “Solid Surface Fabrications”

1.04 SUBMITTAL

A. Shop Drawings: Show fabrication details and connections to adjacent work.

B. Product Data: Manufacturers' catalog sheets, specifications, and installation instructions for plastic laminates, glass and hardware items.

C. Samples:
   1. Plastic Laminate: 12 inch square section, each type.
      a. Color Samples: Manufacturer's standard colors, textures, and finish.
   2. Solid Surface Materials: 12 inch square piece for each color. See Section 06 61 16.
   3. Hardware: 1 of each item required.

PART 2 - PRODUCTS

2.01 CABINETS AND COUNTERTOPS

A. Comply with AWI Section 400 except as otherwise specified herein.

B. Cabinets:
1. Solid Surface Application: Custom Grade, over closed-grain softwood (other than flat grain Douglas Fir) and softwood plywood or particleboard as recommended by Solid Surface manufacturer.
2. For Laminate Finish: AWI Custom Grade, with plastic laminate cover on exposed cabinetwork and on inside face of hinged doors.
3. Construction: Details shall conform to Flush overlay design.
4. Exposed surfaces: HDPL, Grade II: Formica, Wilsonart, Pionite, or equal; solid color from manufacturer's standard selections.
5. Semi-exposed surfaces: Grade III, color to match or be compatible with exposed surfaces; drawer sides, backs and bottoms may be painted or sealed.
6. Doors: Doors shall be 3/4 inches thick, minimum.

C. Countertops: AWI Custom Grade with solid surface cover, including backsplash and endsplash as shown. Solid color from manufacturer's standard selections to be selected by Owner. Either type 1 or 2 below, as selected by the Owner.
1. See Section 06 61 16 for Solid Surface Countertops;

D. Plastic Laminate: NEMA Standards Publication LD3 for the following types; color, texture, and finish as indicated, or if not indicated, as selected by the Owner.
1. Countertops: General Purpose Type; GP 50 Grade; 0.050-inch nominal thickness.
2. Post-Formed Surfaces: Post-forming Type; PF 42 Grade; 0.042-inch nominal thickness.
3. Exposed Surfaces: General Purpose Type; GP 28 Grade; 0.028-inch nominal thickness.
4. Semi-exposed Surfaces: Backer Type; BK 20 Grade; 0.020-inch nominal thickness.

2.02 HARDWARE

A. Provide hardware as required for architectural woodwork, including cabinet hardware and miscellaneous items. Provide dull chrome finish (US26D), or nearest match available, except as otherwise indicated.
1. Closet Rods: Steel tubing with bright nickel finish; Knape & Vogt KV2, or Stanley V7050.
2. Adjustable Shelf Pilaster Standards and Supports: Steel with bright nickel or zinc finish; Knape & Vogt 255 x 256, or Grant 120 x 21.

3. Adjustable Shelf Slotted Standards and Brackets: Steel; satin anachrome or zinc finish, Knape & Vogt 80 x 180 and 179 adjustable brackets, or Garcy 649 x 689 and N768 adjustable brackets.
4. Hinges: Steel for 3/4 inch flush doors; Stanley 1586, or Hager 1822.
5. Drawer Slides: Full extension, 50 lb capacity; Knape & Vogt 1428, or Grant 328.
6. Cabinet Door/Drawer Pulls, Surface: Stanley 4477, or H.B. Ives 237.
7. Sliding Door Pulls, Flush: H.B. Ives 22, or Grant 424.
8. Magnetic Cabinet Door Catches: Stanley SP45, or H.B. Ives 325.
9. Cabinet Drawer Lock: Corbin Cabinet Lock 0666, or National Cabinet Lock M2-3700.
10. Cabinet Door Lock: Corbin Cabinet Lock 0370B, or National Cabinet Lock M2-3702, hand as required.
11. Sliding Door Lock: Corbin Cabinet Lock 02291, or National Cabinet Lock C8042-26D.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the work of this Section in strict accordance with the manufacturer's printed instructions and approved shop drawings (if any).

B. Fit joints neatly and accurately with adjoining surfaces in same plane. Maintain field joint tolerances equal to those specified in AWI Standards.

C. All field joints to be tightly fitted and flush.

D. All casework shall be set plumb, level, straight, and square.

E. Countertops and backsplashes shall be scribed to fit the wall configuration.

F. All loose field joints in countertops must be fastened with mechanical fasteners and splines.

G. All concealed portions of cabinet work shall be finished with one coat of sealer.

H. Fastening:
1. Use concealed fasteners for work to receive transparent finish.
2. Fasten assembled items together securely.
3. Fasten items securely to supporting surfaces.
4. Set exposed nails for putty stopping.
5. Plug stop screws in exposed-to-view surfaces.
6. Perform gluing operations in such a manner that the glued surfaces will be in close contact throughout, firmly cemented together and with joints as nearly invisible as possible.

3.02 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film, glass and cabinetry before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 06 61 16

SOLID SURFACE FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Solid Surface Fabrications, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications identified herein and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.03 SUBMITTALS

A. Submittals: As required by this Section.

B. Shop Drawings: Show fabrication details and connection to all adjacent work.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Samples:
1. Solid Plastic Panels: 12 inch square piece; each color, pattern, and finish.
a. Color Samples: Manufacturer's custom colors, patterns, and finishes.

E. Quality Control Submittals:
1. Qualifications Certificates: Certified statement by technical representative of the panel manufacturer that the fabricator and installer are certified or approved.

F. Contract Closeout Submittals:
1. Maintenance Data: Deliver 2 copies, covering the installed products, to the Owner's Representative.

1.04 QUALITY ASSURANCE

A. Qualifications: The fabrication and installation of the work of this Section shall be performed by a fabricator and installer certified or approved by the solid plastic manufacturer.

1.05 PROJECT CONDITIONS

A. Do not install the work of this Section until the walls and ceilings of the spaces to receive the work have been finished.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Solid Plastic Panels: Avonite solid surfacing by Avonite, Inc., 1945 Highway 304, Belen, NM 87002, (800) 866-8324;

B. CORIAN by DuPont Polymer Products Department, CORIAN Products, Wilmington, DE 19898, (800) 426-7426;

C. Surell Solid Surfacing Material by Formica Corp., 96A Commerce Way, Woburn, MA 01801, (617) 932-5955;

D. Fountainhead sheets by Nevamar Division, International Paper, 8339 Telegraph Rd., Odenton, MD 21113-1397, (410) 551-5000;

E. Swanstone solid surface products by The Swan Corp., One City Centre, St. Louis, MO 63101, (314) 231-8148;

F. Gibraltar Solid Surfacing by Ralph Wilson Plastics Co., Temple, TX 76504, (817) 778-2322.

G. For any product selected above, or approved equal comply with the following:
   1. Color: As selected from manufacturer's full range of color options.
   2. Color and Pattern: As selected from manufacturer's full range of color and pattern options.
   3. Adhesives, Fillers, and Sealants: Panel manufacturer's standard or recommended materials.

2.02 FABRICATION

A. Shop fabricate components to greatest extent possible to sizes and shapes indicated, in accordance with approved shop drawings.

B. Form joints between components using joint adhesive, without conspicuous joints.

C. Provide shop cutouts for fittings and accessories as required and as indicated on the drawings.

D. Cut and finish component edges with clean, sharp returns. Rout radii and contours to template. Repair or replace defective and inaccurate materials.

F. Thermoforming: Comply with panel manufacturer's printed instructions.
1. Form pieces prior to seaming and joining.
2. Prevent blistering, whitening, and cracking of pieces during forming.

G. Inlays: Comply with panel manufacturer's printed instructions.
1. Rout groove for inlay to straight edge or pattern indicated on the drawings.
2. Fill groove using panel manufacturer's inlay filler. Completely fill inlay groove without voids. Overflow inlays area.
3. Sand cured inlay, finish and touch up surface to uniform appearance.

H. Fabrication Tolerances: Plus or minus 1/16 inch overall.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the work of this Section in accordance with the manufacturer's printed instructions, approved shop drawings, and as follows:
1. Install components plumb and level, scribed to adjacent surfaces.
2. Form field joints using adhesive, with joints inconspicuous in finished work.
3. Provide back splashes and end splashes in locations required for a complete finished appearance.
4. Installation Tolerances: Plus or minus 1/8 inch overall.
5. Keep components clean during installation.

3.02 CLEANING:

A. After installation, clean exposed surfaces to remove dirt, adhesive, sealant, and other blemishes. Comply with panel manufacturer's printed cleaning instructions.

3.03 PROTECTION

A. Apply heavy kraft paper or other heavy protective coating approved by the Owner's Representative, masked in place to prevent surface damage.

END OF SECTION

SECTION 07 13 53

ELASTOMERIC WATERPROOFING, SHEET-APPLIED

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Elastomeric Waterproofing, Sheet-Applied, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. D41 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
      b. D146 - Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
      c. D297 - Rubber Products-Chemical Analysis
      d. D412 - Rubber Properties in Tension
      e. D449 - Asphalt Used in Dampproofing and Waterproofing
      f. D471 - Rubber Property-Effect of Liquids
      g. D573 - Rubber-Deterioration in an Air Oven
      h. D624 - Rubber Property-Tear Resistance
      i. D746 - Brittleness Temperature of Plastics and Elastomers by Impact
      j. D816 - Rubber Cements
      k. D822 - Operating Light- and Water-Exposure Apparatus
      l. (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products
      m. D1004 - Initial Tear Resistance of Plastic Film and Sheeting
      n. D1149 - Rubber Deterioration-Surface Ozone Cracking in a Chamber (Flat Specimen)
      o. D1876 - Peel Resistance of Adhesives (T-Peel Test)
      p. D2178 - Asphalt Glass Felt Used in Roofing and Waterproofing
      q. D2240 - Rubber Property-Durometer Hardness
      r. E96 - Water Vapor Transmission of Materials
      s. E154 - Materials for Use as Vapor Barriers Under Concrete Slabs
      t. and as Ground Cover in Crawl Spaces

1.03 SUBMITTALS: Submit the following:

A. Manufacturers Data: Include description of material and its physical properties; application details; recommendations regarding shelf life, application procedures; requirements for protective covering; and precautions for flammability and toxicity.

B. Descriptive Literature:
1. Waterproofing manufacturer's printed installation instructions
2. Manufacturer's descriptive literature covering protection board

1.04 DELIVERY AND STORAGE

A. Deliver and store materials out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked.

1.05 ENVIRONMENTAL CONDITIONS

A. Do not apply waterproofing exposed to inclement weather or when there is ice, frost, surface moisture, or visible dampness on the surface to receive waterproofing and when ambient and surface temperatures are 40 degrees F or below. The restriction on the application of waterproofing materials when ambient and surface temperatures are below 40 degrees F will be waived if the Contractor devises a means, approved by the Engineer, of maintaining the surface and ambient temperatures above 40 degrees F.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide one of the types of sheet-applied elastomeric waterproofings specified herein. Compatibility of waterproofing materials within a specific type, with each other, and with the materials to which they will be applied is required. Materials shall conform to the applicable performance requirements cited below when tested in accordance with the referenced ASTM Publications.

2.02 BUTYL RUBBER SHEETING

A. Not less than 60 mils minimum thickness is required.

B. Performance Requirements:

1.	Thickness tolerance (ASTM D412)	$\pm$ 10 percent
2.	Specific gravity (ASTM D297)	1.20, $\pm$ .05
3.	Tensile strength (ASTM D412)	1200 psi (min.)
4.	Tensile stress at 300 percent elongation (ASTM D412)	600 psi (min.)

5.	Elongation (ASTM D412)	300 percent (min.)
6.	Tear resistance, Die C (ASTM D624)	125 lbf/inch (min.)
7.	Shore A hardness (ASTM D2240), 5-second interval before reading	60 $\pm$ 10
8.	Ozone resistance (ASTM D1149)	No cracks, 7 days/50 pphm/100 degrees F/ 20 percent elongation
9.	Heating aging-accelerated (ASTM D573), tensile retention, 60 percent of minimum original elongation retention, 60 percent of minimum original requirement	7 days/240 degrees F
10.	Butyl identification (ASTM D471), tricresyl phosphate immersion	Maximum volume swell 10 percent, 70 hrs/212 degrees F
11.	Low temperature flexibility (ASTM D746)	No failure at -40 degrees F
12.	Water absorption (ASTM D471) 158 degrees F	7 days + 1 percent (max.)
13.	Exposure to fungi and bacteria in soil, minimum 16 weeks	Unaffected
14.	Water vapor transmission, 80 degrees F permeance (ASTM E96, Procedure B or BW)	0.15 perms (max.)

C. Adhesive, Cement, and Tape for Use with Butyl Rubber: As recommended by the butyl-rubber waterproofing membrane manufacturer.

D. Cement for Splicing: Self-vulcanizing butyl rubber compound.

E. Butyl Gum Tape for Splices: Black, unvulcanized butyl rubber with polyethylene backing.

2.03 PLASTIC ELASTOMERIC SHEETING

A. In addition to the following requirements, provide plastic elastomeric sheeting not less than 56 mils thick on vertical surfaces and not less than 45 mils thick on horizontal surfaces.

B. Vertical Surfaces:

1. Performance Requirements for Membrane:

a.	Tensile strength (ASTM D412)	2200 psi (min.)
b.	Ultimate elongation (ASTM D412)	200 percent (min.)
c.	Tear resistance (ASTM D1004)	325 lbf/in. width (min.)
d.	Water vapor transmission, 80 degrees F, permeance (ASTM E96, Procedure B)	0.25 perms (max.)

e.	Cold brittleness, degrees F (ASTM D746	Zero degrees (max.)
f.	Accelerated aging (ASTM D822)	No visible deterioration after 400 hours
g.	Exposure to fungi and bacteria in soil, minimum 16 weeks	Unaffected

2. Adhesive: Asphalt- or rubber-based solvent type as recommended by the plastic elastomeric sheeting manufacturer. Lap shear strength (ASTM D816) requirements for adhesive are as follows:

a.	Aged one week at 75 degrees F	10 psi (min.)
b.	Aged 2 weeks in water at 75 degrees F	7 psi (min.)

C. Horizontal Surfaces:

1. Elastomeric Sheet Membrane: Factory laminated to an asphalt glass felt, ASTM 2178, providing a minimum overall thickness of not less than 45 mils. Performance requirements specified above for plastic elastomeric sheeting membrane for vertical surfaces apply.
2. Adhesive: ASTM D449, Type II asphalt unless otherwise specified in the plastic elastomeric sheeting manufacturer's printed recommendations.

2.04 CHLORINATED POLYETHYLENE SHEETING

A. Uncured, chlorinated-polyethylene, synthetic elastomer sheeting of 40 mils nominal thickness.

B. Performance Requirements for Membrane:

1.	Tensile strength (ASTM D412)	1600 psi (min.)
2.	Percent elongation (ASTM D412)	400 percent (min.)
3.	Specific gravity (ASTM D624)	1.33 $\pm$ 0.05
4.	Tear resistance, Die C (ASTM D624)	175 lb/in. (min.)
5.	Shore A hardness (ASTM D2240), 10-second interval before reading	74 $\pm$ 10
6.	Water vapor transmission, 100 degrees F permeance (ASTM E96, Procedure E)	0.10 perms (max.)
7.	Low temperature brittle point (ASTM D746) 0.020-inch gage	No failure at -50 degrees F
8.	Exposure to fungi & bacteria in soil, minimum 16 weeks	Unaffected
9.	Accelerated Environmental Resistance	
a.	Aging, 7 days at 250 degrees F (121 degrees C) in forced convection oven	
1)	Elongation retained	300 percent (min.)
2)	Weight loss	3 percent (max.)
b.	Alkali, immersed 30 days at 140 degrees F (60 degrees C) in 10 percent NaOH	
1)	Elongation retained	300 percent (min.)

2) Weight loss 3 percent (max.)

c. Hydrocarbon resistance, immersed 24 hrs. at 122 degrees F (50 degrees C) in U.S.P. Mineral Oil
   1) Elongation retained 300 percent (min.)
   2) Weight loss 2 percent (max.)

C. Solvent Welding Agent and Adhesive: As recommended by the elastomeric sheet material manufacturer's printed installation instructions. Bond strength when tested in accordance with ASTM D1876 at 75 degrees F for one week shall be not less than 10 pound force per inch (lbf/in.) of width, and after 2 weeks shall be not less than 7 (lbf/in.) of width.

2.05 COMPOSITE, SELF-ADHERING MEMBRANE SHEETING

A. Not less than 60 mils thickness is required.

B. Performance Requirements:

1.	Tensile strength (ASTM D412, Die C)	250 psi (min.)
2.	Ultimate elongation (ASTM D412, Die C)	200 percent (min.)
3.	Water vapor transmission, 80 degrees F permeance (ASTM E96, Procedure B)	0.1 (max.)
4.	Pliability degrees F (ASTM D146) (180 degrees bend over one-inch mandrel)	No cracks at minus 25 degrees F
5.	Cycling over crack at minus 15 degrees F (Membrane is applied and rolled across two primed concrete blocks with no separation between blocks. Crack opened and closed from zero to 1/4 inch.)	100 Cycles (min.) No effect
6.	Puncture resistance (ASTM E154)	40 lb. (min.)

C. Primer: Asphalt composition, ASTM D41, or synthetic polymer in solvent as recommended by the membrane manufacturer.

D. Mastic: Polymer modified asphalt in suitable solvent of trowel-grade consistency and as recommended by the membrane manufacturer.

PART 3 - EXECUTION

3.01 CONDITION OF SURFACES

A. Inspection of Surfaces: Before starting the work, determine that surfaces to be waterproofed are in satisfactory condition. Notify the Engineer of defects or conditions that will prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

B. Preparation of Surfaces: Ensure surfaces to be treated are clean, dry, smooth, and free from deleterious materials and projections. Thoroughly wet holes, joints, cracks, and voids in masonry and concrete with water and fill with Portland cement mortar, strike flush, and permit to dry. Cut off or grind smooth, high spots. Finish top surfaces of projecting masonry or concrete ledges below grade, except footings, to a steep bevel with Portland cement mortar. Sweep surfaces to be covered before waterproofing is applied, to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system.

3.02 APPLICATION

A. Follow manufacturer's printed installation instructions. Where indicated, mop continuous cant strips in place at vertical and horizontal corners before installing the waterproofing membrane. Do not use untreated wood or wood fiber cants. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor. Provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces as indicated and cement solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement. Continue membrane through walls, floors, piers, and columns, unless otherwise shown.

1. Non-self-adhering membrane: Unroll the membrane and allow to remain flat for at least one-half hour before application. Use an asphalt concrete primer prior to application of asphaltic adhesive. Where solvent-type adhesive is used, allow major portion of solvent to evaporate so that bonding adhesive does not stick to a dry finger touching it. Apply elastomeric waterproofing membrane in a full bed of adhesive at a uniform coverage rate in accordance with the recommendations in the membrane manufacturer's printed instructions. Where membrane on horizontal surfaces is to receive concrete fill, apply adhesive in 4-inch wide strips at 2 feet on centers. Draw membrane tight without stretching. As soon as the adhesive is fully set and dry, recheck lap splices. Where any openings or fishmouths appear, reseal and reroll lap splices.
2. Self-adhering membrane: Apply composite, self-adhering membrane on surfaces primed at a uniform coverage rate in accordance with the membrane manufacturer's printed instructions. Remove release sheet and apply with tacky surface in contact with the dried primer.
    a. Protection: Protect membrane over horizontal surfaces from abnormal traffic during installation. Use only equipment with rubber tires. Provide walkway protection where heavy traffic from other trades is expected. Do not store material on the membrane.

B. Butyl Rubber: Lap sheets at sides and ends a minimum of 4.25 inches over the preceding sheet. Clean lap splice areas of membrane with heptane, unleaded, or white gasoline. Apply 4.25-inch wide unvulcanized, compounded butyl tape between lapped sheets so that the tape extends approximately 1/4 inch beyond the exposed sheeting edge. Roll or press the tape firmly into place as it is applied. Remove the tape backing, and roll or press the overlapping sheets into place.

Apply splicing cement to the lapped area 3.5 inches on either side of the lapped edge and allow to dry thoroughly. Reinforce the lap splice with a second, 6-inch wide, unvulcanized, compounded butyl tape. Reinforce corner splices and flashing overlaps with a 12-inch wide strip of membrane over one layer of butyl tape, or reinforce with prefabricated corner of butyl rubber. Obtain full contact in reinforced areas. Seal laps and splices with lap sealant prior to completion of a day's work.

C. Plastic Elastomeric Sheeting:

1. Vertical Surfaces: Apply sheeting in sections not longer than 18 feet. Lap sheets at sides and ends a minimum of 6 inches over the preceding sheet. Reinforce lapped sheets with 12-inch wide strip of plastic sheeting or as recommended by the manufacturer of sheeting material. Reinforce corner splices and flashing overlaps with a 12-inch wide strip of membrane embedded in adhesive. Seal laps and splices in a full bed of adhesive at the rate recommended by the manufacturer of the material. Roll the sheeting and joint strip with 50 - 100 pound roller on horizontal surfaces and 6-inch rubber hand roller on vertical surfaces.
2. Horizontal Surfaces: Apply sheeting over horizontal surfaces with the fiberglass-felt side facing the surface to which it is adhered, in a full bed of asphalt-based adhesive, at the rate recommended by the manufacturer of the material. Lap sheets a minimum of 4 inches over preceding one at sides and 6 inches at ends.

D. Chlorinated Polyethylene Sheeting: Lap sheets at edges and ends not less than 2 inches over the preceding sheet. When solvent welding agent is used, clean lap and splice areas of membrane before applying welding agent, as required by the printed installation instructions of the manufacture of the sheeting.

E. Composite, Self-Adhering Membrane: Lap sheets at edges and ends a minimum of 2.5 inches over the preceding sheet. Roll or firmly press to adhere membrane to the substrate. Cover corners and joints with two layers of reinforcement by first applying a 12-inch width of membrane centered along the axis. Flash drains and projections with a second ply of membrane for a distance of 6 inches from the drain or projection. Finish exposed, terminated edges of membrane on horizontal or vertical surfaces with a troweled bead of mastic. Apply mastic around edges of membrane, and all drains and projections. Apply mastic at end of each day's work.

3.03 FLASHING

A. Flash penetrations through membrane. Embed elastomeric membrane in a heavy coat of adhesive, except for self-adhering membrane. Continuous metal reglets shall be installed, horizontally on footing and vertically on intersecting and connecting walls, and as specified in Section "Flashing and Sheet Metal". Metal reglets shall receive the exposed edges of membrane waterproofing. Secure membrane into reglets by lead wedges and fill with cement as recommended by

manufacturer of the waterproofing materials. Counterflash upper edge of membrane waterproofing and protective covering as specified in Section 07 60 00.

3.04 FIELD TESTS

A. Notify the Engineer one day prior to the date of performing tests. Before concealment, cover elastomeric waterproofing on horizontal surfaces over finished spaces with 3 inches of ponded water for 24 hours. There shall be no water added after the start of the 24-hour period. Carefully measure water level at the beginning and end of the 24-hour period. If the water level falls, remove the water and inspect the waterproofing membrane. Make repairs or replacement as directed, and repeat the test. Work that conceals membrane waterproofing shall not proceed before approval and acceptance by Engineer.

3.05 PROTECTIVE COVERING

A. After the installation has been inspected and approved by the Engineer, apply a protective covering to the membrane waterproofing prior to backfilling. Protect vertical membrane waterproofing with a 1/2 inch, minimum, thickness of asphalt plank; 1/2 inch, minimum, thickness of fiberboard; or 1/8 inch, minimum, thickness of compatible water-resistant (bitumen type) protection board with edges abutting adjacent edges and exposed surfaces covered by a taping system recommended by manufacture of protection board. Cover horizontal membrane waterproofing with similar protection board and Portland cement mortar not less than 3/4 inch thick; place uniformly and allow to set before installing subsequent construction.

END OF SECTION

SECTION 07 21 13.02

PERIMETER AND UNDER-SLAB INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Perimeter and Under-Slab Insulation, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. C552 - Cellular Glass Thermal Insulation
      b. C578 - Rigid, Cellular Polystyrene Thermal Insulation
      c. C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
      d. C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
      e. D2822 - Asphalt Roof Cement
      f. F1667 - Driven Fasteners: Nails, Spikes and Staples

1.03 SUBMITTALS

A. Manufacturer's Catalog Data: Manufacturer's Data: Include descriptive literature, and recommended instructions on installation methods and procedures for the following:
   1. Insulation
   2. Asphalt roof cement

1.04 DELIVERY AND STORAGE

A. Deliver materials to the site in the original sealed packages bearing the manufacturer's name and designation, specification number, type, and class. Protect material from damage during construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Insulation: ASTM C578 polystyrene board, extruded closed cell. Thickness indicated.
   1. Perimeter Insulation: ASTM C578, Type IV, minimum compressive strength of 25 pounds per square inch at 10 percent deformation.

B. Asphalt Roof Cement: ASTM D2822.

C. Masonry Nails: ASTM F1667, Type I, Style 11, 17, or 27.

D. Clips: Type as recommended by insulation manufacturer and approved.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Insulation on Foundation Walls: As indicated. Fasten insulation to the wall with masonry nails, asphalt roof cement, or clips.

B. Insulation for Floating Slab Foundations: As indicated. Fasten insulation to the edge of floating slab foundations with masonry nails, asphalt roof cement, or clips.

END OF SECTION

SECTION 07 21 16

CEILING, WALL, AND FLOOR INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Ceiling, Wall, and Floor Insulation, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. C423 - Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
      b. C578 - Rigid Cellular Polystyrene Thermal Insulation
      c. C612 - Mineral Fiber Block and Board Thermal Insulation
      d. C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
      e. C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
      f. D4397 - Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
      g. E84 - Surface Burning Characteristics of Building Materials
      h. E96 - Water Vapor Transmission of Materials

1.03 SUBMITTALS

A. Submit the following.
   1. Manufacturer's Catalog Data:
      a. Insulation
      b. Vapor retarder
      c. Clip fastener
      d. Adhesive
      e. Duct tape
      f. Wire mesh

1.04 DELIVERY AND STORAGE

A. Deliver materials to the site in the original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect materials from damage. Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 - PRODUCTS

2.01 THERMAL RESISTANCE VALUE (R-VALUE)

A. As indicated

2.02 BATT OR BLANKET INSULATION

A. ASTM C665, Type I, blankets without membrane coverings and Type II, PSK blankets or Type III, FSK blankets. Type II and Type III shall be Class A, with a flame spread of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

2.03 SILL SEALER INSULATION

A. ASTM C665, Type I.

2.04 BLOCK OR BOARD INSULATION

A. Polystyrene: ASTM C578, Type I.

B. Urethane: ASTM C1289, Type I.

2.05 VAPOR RETARDER

A. ASTM D4397, 10-mil thick polyethylene sheeting with a water vapor permeance of 1 perm or less when tested in accordance with ASTM E96. Vapor retarder shall be flame retardant with a flame spread of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

2.06 ACCESSORIES

A. Adhesive: As recommended by the insulation manufacturer.

B. Clip Fasteners: Zinc-coated steel consisting of a perforated base plate with a projecting split prong of appropriate type and length to penetrate insulation the full thickness of the insulation and bent back flush with the insulation surface.

C. Duct Tape: As recommended by the insulation manufacturer.

D. Wire Mesh: As recommended by the insulation manufacturer.

2.07 ACOUSTICAL VALUES:

A. ASTM C423.

PART 3 - EXECUTION

3.01 PREPARATION OF SURFACES

A. Surfaces shall be clean, dry, and free of any projections.

3.02 INSTALLATION OF BATT OR BLANKET INSULATION

A. Wall: Place insulation with affixed vapor retarder with vapor retarder towards the interior (warm-in-winter) side of the construction. Apply insulation around and to the rear of electrical devices. Place insulation to the outside (cold side) of all pipes.
   1. Installation at Sill: Size sill sealer insulation and place insulation over top of masonry or concrete perimeter walls or concrete perimeter floor slab on grade. Fasten sill plate over insulation.
   2. Installation at Metal Framing and Furring Members: Size insulation to the width of members spacing. Press friction-fit insulation between the members as recommended by the insulation manufacturer. Cover entire wall with a separate vapor retarder as specified herein.

3.03 INSTALLATION OF BLOCK OR BOARD INSULATION

A. Walls: Apply insulation to the rear of electrical devices. Place insulation to the outside (cold side) of all pipes.
   1. Installation at Wood, Metal, and Insulated Furring Members: Install insulation as recommended by the insulation manufacturer.
   2. Adhesive Attachment on Concrete and Masonry Walls: Apply adhesive to the wall and completely cover wall with insulation using as recommended by the insulation manufacturer. Use the full back method for insulation less than one square foot. Butt all edges of insulation and seal edges with tape.
   3. Clip Fastener Attachment on Concrete and Masonry Walls: Cut insulation to cover walls. Apply adhesive to the wall and set clip fasteners in adhesive as recommended by the insulation manufacturer. After curing of adhesive, install insulation over fasteners, and bend the split prongs flush with the insulation to secure. Butt all edges of insulation and seal edges with tape.

3.04 INSTALLATION OF VAPOR RETARDER

A. Apply a continuous retarder on the interior side (warm-in-winter) of the ceiling wall and floor construction as recommended by the insulation manufacturer. Repair punctures or tears with duct tape.

END OF SECTION

SECTION 07 22 16

ROOF INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Roof Insulation, as shown of the Plans, as specified and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Society For Testing and Materials (ASTM) Publications:
   a. C208 - Cellulosic Fiber Insulating Board
   b. C552 - Cellular Glass Thermal Insulation
   c. C578 - Rigid Cellular Polystyrene Thermal Insulation
   d. C726 - Mineral Fiber Roof Insulation Board
   e. C728 - Perlite Thermal Insulation Board
   f. C984 - Perlite Board and Rigid Cellular Polyisocyanurate Composite Roof Insulation
   g. C1050 - Rigid Cellular Polystyrene-Cellulosic Fiber Composite Roof Insulation
   h. C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
   i. D41 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
   j. D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
   k. D312 - Asphalt Used in Roofing
   l. D2178 - Asphalt Glass Felt Used in Roofing and Waterproofing
   m. D2626 - Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing
   n. D2822 - Asphalt Roof Cement
   o. E84 - Surface Burning Characteristics of Building Materials
   p. Factory Mutual Engineering and Research Corporation (FM) Publications:
   q. AG - Approval Guide
   r. D/S1-28 - Design Wind Loads, Property Loss Prevention Data Sheet
2. Underwriters Laboratories, Inc. (UL) Publication:
   a. BMD Building Materials Directory

1.03 SUBMITTALS

A. Manufacturer's Instructions:
   1. Roof insulation:
      a. Submit recommendations for location and spacing of wood nailers, spacing of fasteners for the portion of vapor retarder in contact with gypsum decks, minimum thickness of insulation for steel decks, and fastener pattern for insulation on steel decks.
   2. Samples:
      a. Roof insulation
      b. Vapor retarder
      c. Mechanical fasteners
         1) Mechanical fasteners shall include nails, staples, caps or plates used to apply the insulation.
   3. Test Reports:
      a. Roof insulation
         1) Submit insulation material's flame spread and smoke developed ratings, in accordance with ASTM E84.

1.04 QUALITY ASSURANCE

A. The roof insulation, except for installation on poured-gypsum roof decks, poured-concrete roof decks or precast roof deck panels or planks listed in the FM Approval Guide as noncombustible roof deck construction, shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E84. Insulation bearing the UL label and listed in the UL Building Materials Directory as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of certified test reports. Compliance with the flame spread and smoke developed ratings will not be required when the insulation has been tested as a part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL BMD or listed as Class I roof deck construction in the FM AG. Insulation tested as a part of a roof construction assembly shall be provided with UL or FM labels attesting to the ratings specified herein.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver the materials to the site in the manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:
   1. Name of manufacturer
   2. Brand designation
   3. Specification number, type, and class, as applicable, where materials are covered by a referenced specification.

4. Asphalt's flashpoint (FP), equiviscous temperature (EVT), and finished blowing temperature (FBT).
    a. This information shall be shown on the accompanying bills of lading if not shown on the containers or packages. Deliver the materials in sufficient quantity to allow continuity of the work.

B. Storage and Handling: Store and handle the materials in a manner to protect the materials from damage, exposure to open flame, or other ignition sources, and from wetting and moisture absorption during the entire construction period. Store the materials on pallets or platforms, and cover exposed-to-weather surfaces with waterproof canvas tarpaulins. Store felt rolls on ends. For the 24 hours immediately before application of the felts, store the felts in an area maintained at a temperature not lower than 50 degrees F. Replace damaged material with new material.

1.06 ENVIRONMENTAL CONDITIONS

A. Do not install roof insulation during inclement weather or when the ambient temperature is below 40 degrees F or when there is ice, frost or moisture visible on the roof deck.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Roof Insulation:
    1. Roof Insulation Types: Roof insulation shall be one or more of the following materials.
        a. Mineral Fiber and Glass Fiber Board: ASTM C726.
        b. Expanded Perlite Board: ASTM C728.
        c. Cellular Glass Boards: ASTM C552, Type IV.
        d. Polyurethane or Polyisocyanurate Board: ASTM C1289, Type II, Class 1, Grade 2 or 3, minimum compressive strength shall be 20 pounds per square inch.
        e. Composite Boards: ASTM C1289, Type III, perlite insulation board faced one side, fibrous felt or glass fiber mat membrane on other side. Type V, oriented strand board or waferboard on one side and fibrous felt or glass fiber mat membrane or aluminum foil on the other. Type VI, perlite insulation board on both major surfaces of the core foam; ASTM C984 (Polyisocyanurate-perlite); or ASTM C578 (Polystyrene), Type IV, factory bonded between outer layers of expanded perlite; or ASTM C1050 (Polystyrene-wood fiberboard), Type III, Grade 1, Class A.

2. Insulation Thickness: As necessary to provide a coefficient of heat transmission (U-value) of 0.032 Btu/hr/sq ft/degree F or less, except over steel decks the insulation thickness shall satisfy both the specified U-value and minimum thickness for the width of rib opening recommended in the insulation manufacturer's published literature. Calculate the thickness of polyurethane or polyisocyanurate board using a K-value of 0.18.

B. Cants and Tapered Edge Strips: Provide preformed cant and tapered edge strips of the same material as the roof insulation; or, if roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer.

C. Asphalt Primer: ASTM D41.

D. Asphalt: ASTM D312, Type III or IV.

E. Asphalt Roof Cement: ASTM D2811, Type I.

F. Vapor Retarder:
1. Rosin-sized Building Paper or Unsaturated Felt: Weighing not less than 5 pounds per 100 square feet.
2. Asphalt-saturated Felt: ASTM D226, Type I.
3. Asphalt-saturated Felt Base Sheet: ASTM D2626.
4. Asphalt-coated Glass Felt: ASTM D2178, Type IV.

G. Wood Fiberboard Overlayment: ASTM C208.

H. Nails and Fasteners: Flush-driven through flat round or hexagonal plates. Minimum withdrawal resistance of the nails or approved fasteners from the deck shall be 40 pounds each, 120 pounds each in steel deck.
1. Fasteners for Gypsum Decks: Special self-clinching fasteners approved by the deck material manufacturer.
2. Fasteners for Steel Decks: Approved hardened penetrating fasteners or screws for securing the insulation to steel decks. Design fasteners to be driven through the roof deck. Fasteners shall be approved and listed in the FM Approval Guide for Class I roof deck construction. Length of the fasteners shall be governed by thickness of insulation. Fasteners shall be of the quantity and placed in a pattern to withstand an uplift pressure of 90 pounds per square foot.

I. Plates: Steel or plastic.
1. Steel Plates: Flat round plates not less than 1-3/8-inch diameter or hexagonal plates of zinc-coated steel not lighter than 28 gauge. The plate shall be formed to prevent dishing. Do not use bell- or cup-shaped plates.
2. Plastic Plates: High-density, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. The fastener head shall recess fully into the plate after driving.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Surfaces on which the vapor retarder and insulation are to be installed shall be firm, clean, smooth, and dry. Surfaces receiving the vapor retarder shall be free of projections which might puncture the vapor retarder. Check the roof deck surfaces, including surfaces sloped to the roof drains and outlets, for defects before work is started. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex. Examine precast concrete decks to ensure that joints between precast units are properly grouted and leveled to provide suitable surfaces for the installation of the vapor retarder and insulation. The Contractor shall inspect and approve the surfaces immediately before installation is started.

3.02 PREPARATION

A. Protection:
   1. Flame-heated Equipment: Locate and use flame-heated equipment so as not to endanger the structure or other materials on the site or adjacent property. Do not place flame heating equipment on the roof. Provide and maintain a fire extinguisher near each item of flame-heated equipment.
   2. Protective Coverings: Install protective coverings at paving and building walls adjacent to the hoist and kettles prior to starting the work. Lap protective coverings at least 6 inches, secure them against wind, and vent them to prevent collection of moisture on the covered surfaces. Keep protective coverings in place for the duration of the work with asphalt products.
   3. Special Protection: Provide approved special protection, or avoid heavy traffic on the completed work when the ambient temperature is greater than 80 degrees F.
   4. Drippage of Bitumen: Seal joints in and at edges of the deck as necessary to prevent drippage of bitumen into the building or down exterior walls.

B. Surface Preparation: Correct defects and inaccuracies in the roof deck surface to eliminate poor drainage and hollow and low spots.

3.03 APPLICATION

A. Keep roof insulating materials dry before, during, and after installation. Keep the insulation 1/2 inch clear of vertical surfaces penetrating and projecting from the roof surface.

B. Temperature of Asphalt: When installing the vapor retarder and insulation, apply asphalt when temperature of the asphalt is within plus or minus 25 degrees F of the equiviscous temperature (EVT). Do not heat the asphalt to the flashpoint (FP). Do not heat the asphalt above the asphalt's finish blowing temperature (FBT) or 525 degrees F, whichever is less, for longer than 4 consecutive hours.

Use thermometers to check temperatures during heating and application. Have kettlemen in attendance at all times during the heating process to ensure that the maximum temperatures specified are maintained.

C. Wood Nailers: Pressure-preservative treated wood nailers shall be as specified in Section 06 10 01, "Rough Carpentry." Verify prior to the installation of the insulation that nailers the same thickness as the insulation have been provided at eaves, edges, curbs, walls, and roof openings for securing cant strips, gravel stops, gutters, and flashing flanges. On decks with slopes of 1/2 inch or more, surface-applied wood nailers shall be installed perpendicular to the slope for securing the insulation and for backnailing of roofing felts. Space nailers in accordance with the recommendations of the insulation and roofing materials manufacturer.

D. Priming of Poured or Precast Concrete Decks: Solidly apply asphalt primer at the rate of one gallon per 100 square feet of roof surface, stopping approximately 4 inches from joints between the precast concrete units. Allow the primer to dry thoroughly before installing vapor retarder and insulation. Place felt strips, 4 inches or more in width, over joints (2 inches on each side) between precast concrete units in a heavy coating of cold-applied asphalt roof cement.

E. Vapor Retarder: Install vapor retarder in direct contact with the roof deck surface. The vapor retarder shall consist of either two plies of No. 15 asphalt-saturated felt, two plies of asphalt-coated glass felt, or one layer of asphalt-saturated felt base sheet weighing not less than 35 pounds per 100 square feet. Lay the vapor retarder at right angles to the direction of the slope. Install the first ply of felt or base sheet as specified herein for the specified substrate. Solidly mop in place with asphalt the second ply of the two-ply vapor retarder system. Apply asphalt at the rate of 20 to 35 pounds per 100 square feet. The vapor retarder shall be free of wrinkles of buckles. Press out air bubbles to obtain complete adhesion between the surfaces. At walls, edges, and other vertical projections, extend the vapor retarder 6 inches to form a lap which shall later be wrapped around the edge of the insulation on top of the vapor retarder.

1. Vapor Retarder on Poured Concrete Decks: Solidly mop the substrate with asphalt before the vapor retarder is installed. Lay the first ply of the two-ply vapor retarder system with each sheet lapping 19 inches over the preceding sheet. Provide end laps not less than 4 inches, and stagger laps a minimum of 12 inches. Cement felts together with a solid mopping of asphalt. Apply asphalt moppings at the rate of 20 to 35 pounds per 100 square feet. For a vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inches over the preceding sheet. Provide end laps not less than 4 inches, and stagger laps a minimum of 12 inches. Cement base sheets together with a solid mopping of asphalt.
2. Vapor Retarder on Precast Concrete Decks: Solidly mop the substrate with asphalt before the vapor retarder is installed. Lay the first ply of the two-ply vapor retarder system with each sheet lapping 19 inches over the preceding sheet. Provide end laps not less than 4 inches, and stagger the laps a minimum of 12 inches. Cement felts together with a solid mopping

of asphalt. Apply asphalt moppings at the rate of 20 to 35 pounds per 100 square feet. For a vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inches over the preceding sheet. Provide end laps not less than 4 inches, and stagger laps a minimum of 12 inches. Cement base sheets together with a solid mopping of asphalt.

3. Vapor Retarder on Gypsum: Lay the first ply of two-ply vapor retarder system dry with each sheet lapping 2 inches over the preceding sheet. Provide end laps not less than 4 inches, and stagger the laps a minimum of 12 inches. Fasten the portion of felt in contact with the gypsum deck with special self-clinching fasteners. For the vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inches over the preceding sheet. Provide end laps not less than 4 inches, and stagger the laps a minimum of 12 inches. Cement the side and end laps together with a solid mopping of asphalt or a heavy coat of asphalt roof cement. Apply asphalt moppings at the rate of 20 to 35 pounds per 100 square feet. Fasten the portion of the base sheet in contact with the gypsum deck as specified herein for the two-ply vapor retarder system. Space fasteners in accordance with the approved recommendations of the gypsum manufacturer.

4. Vapor Retarder on Steel Decks: Secure directly to the steel deck a layer of insulation board conforming to the requirements specified in the paragraph entitled, "Roof Insulation" of this Section, of sufficient minimum thickness to span the width of a deck rib opening, and conform to the fire safety requirements. Secure the insulation to the deck with piercing or self-drilling, self-tapping fasteners. Engage the fasteners by driving them through the insulation into the top flange of the steel deck. Insulation joints parallel to the ribs of the deck shall occur on solid bearing surfaces only, not over open ribs. Solidly mop the insulation surface with asphalt before the vapor retarder is installed. Apply asphalt moppings at the rate of 20 to 35 pounds per 100 square feet. For a two-ply vapor retarder, install each sheet lapping 19 inches over the preceding sheet. Provide end laps not less than 4 inches, and stagger the laps a minimum 12 inches. Cement felts together with a solid mopping of asphalt. For a vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inches over the preceding sheet. Provide end laps not less than 4 inches, and stagger laps a minimum of 12 inches. Cement base sheets together with a solid mopping of asphalt.

F. Insulation: Install insulation over a vapor retarder which has been installed as specified. Apply insulation in multiple layers if the total required thickness of insulation exceeds 1/2 inch. Lay insulation so that the continuous longitudinal joints are perpendicular to the direction the felts for the built-up roofing, and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, joints of each succeeding layer shall be parallel and offset in both directions with respect to the layer below. Firmly embed each layer in a solid asphalt mopping; mop only a sufficient area to provide complete embedment of one board at a time. Use 20 to 35 pounds of asphalt per 100 square

feet of roof deck for mopping each layer of insulation in place, except for the layer of insulation in contact with the steel deck which shall be secured only with penetrating type fasteners or screws. On projects where composite boards consisting of polystyrene insulation are provided, apply 6-inch-wide, 15-pound, asphalt-saturated felt strips or glass-fiber roofing tape centered over the joints and edges of the boards. Apply the joint strips with a taping machine or by solid back-mopping of the strips and, while the asphalt temperature is between 225 degrees F and 290 degrees F, flop the strips into position.

1. Insulation on Steel Decks: Secure insulation to the deck with piercing or self-drilling, self-tapping fasteners. Engage the fasteners by driving them through insulation into the top flange of the steel deck. Use the driving method prescribed by the fastener manufacturer. Insulation joints parallel to the ribs of the deck shall occur on solid bearing surfaces only, not over open ribs. When multiple layers of insulation are used, mop in the second layer and succeeding layers as specified for mopping layers of insulation in place.
2. Insulation Over Top Surface of Foam Board: On projects where polyurethane or polyisocyanurate foam board roof insulation is provided, install a 1/2-inch thick layer of mineral fiber, wood fiberboard, or expanded perlite board insulation over the top surface of the foam board insulation. Embed the insulation in a solid asphalt mopping as specified for mopping layers of insulation in place. Stagger joints of insulation with respect to the foam board insulation below.

G. Cant Strips: Where indicated, provide cant strips at intersections of the roof with walls, parapets, and curbs extending above the roof. The face of the cant strips shall have an incline of 45 degrees. Wood cant strips shall bear on and be anchored to the wood blocking. Cant strips shall fit flush against vertical surfaces. Where possible, nail the cant strips to adjoining surfaces. Where cant strips are installed against unnailable materials, install the cant strips in a heavy mopping of asphalt or set in a heavy coating of asphalt roof cement.

H. Tapered Edge Strips: Where indicated, provide edge strips in the right angle formed by the junction of the roof and wood nailing strips that extend above the level of the roof. Edge strips shall be tapered from the top of the wood nailing strips to approximately 1/8 inch at a slope of one to 1-1/2 inches per foot. Install edge strips flush against the vertical surfaces of the wood nailing strips. Where possible, nail the edge strips to adjoining surfaces. Where installed against unnailable materials, install edge strips in a heavy mopping of asphalt or set in a heavy coating of asphalt roof cement.

3.04 PROTECTION

A. Protection of Applied Insulation: Completely cover each day's installation of insulation with the finished roofing specified. Do not permit phased construction. Protect the open ends of each day's work with temporary water cutoffs, and remove when work is resumed. Protect open spaces between insulation and

parapets or other walls and spaces at curbs, scuttles, and expansion joints, until the permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on the insulation or on the roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute the weight to conform to indicated live load limits of roof construction.

B. Damaged Work and Materials: Restore work and materials that become damaged during construction to the original condition or replace with new materials.

END OF SECTION

SECTION 07 22 16.01

TAPERED ROOF INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Tapered Roof Insulation as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American Society For Testing and Materials (ASTM) Publications:
   a. C208 - Cellulosic Fiber Insulating Board
   b. C552 - Cellular Glass Thermal Insulation
   c. C578 - Rigid Cellular Polystyrene Thermal Insulation
   d. C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
   e. C726 - Mineral Fiber Roof Insulation Board
   f. C728 - Perlite Thermal Insulation Board
   g. C1289 - Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
   h. D41 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
   i. D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
   j. D312 - Asphalt Used in Roofing
   k. D2626 - Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing
   l. D2822 - Asphalt Roof Cement
   m. E84 - Surface Burning Characteristics of Building Materials
2. Factory Mutual Engineering and Research Corporation (FM) Publications:
   a. D/S1-28 - Design Wind Loads, Loss Prevention Data Sheet 1-28
   b. AG - Approval Guide
3. Underwriters Laboratories, Inc. (UL) Publication:
   a. BMD - Building Materials Directory

1.03 SUBMITTALS

A. Submit the following:
   1. Manufacturer's Catalog Data:
      a. Tapered roof insulation
   2. Tapered Roof Insulation Data: Show the recommendations for the following:
      a. Location and spacing of wood nailers
      b. Type of insulation material and sequence of laying
      c. Minimum thickness of insulation for steel decks
      d. Fastener spacing for vapor retarder installed over gypsum decks.
   3. Drawings:
      a. Tapered roof insulation system
         1) Show a complete description of the procedures for the installation of each phase of the system indicating the type of materials, thicknesses, identity codes, sequence of laying insulation, location of ridges and valleys, special methods for cutting and fitting of insulation, and special precautions. The manufacturer's drawings, based on field measurements, may be submitted to supplement the information shown on the shop drawings.
   4. Samples:
      a. Insulation
      b. Vapor retarder
      c. Fasteners
   5. Statements:
      a. Installer qualifications
         1) Submit certificate from the insulation manufacturer attesting that the installer is qualified to install tapered roof insulation systems.
   6. Test Reports:
      a. Insulation
         1) Test insulation in accordance with ASTM E84 for flame spread and smoke developed ratings.
   7. Certificates of Compliance:
      a. Roof insulation
      b. Steep asphalt
      c. Asphalt roof cement
      d. Asphalt felt

1.04 DELIVERY AND STORAGE

A. Delivery: Deliver materials in original, sealed containers or packages. Label the containers with manufacturer's name and brand designation. Where materials are covered by a referenced specification, label the containers or packages with specification number, type, and class, as applicable. Each container of asphalt shall bear the flashpoint (FP), equiviscous temperature (EVT), and finished blowing temperature (FBT), or show this information on the accompanying bills of lading. Deliver materials in sufficient quantity to allow work to proceed without interruption.

B. Storage: Store and handle materials in a manner to protect them from damage, exposure to open flame or other ignition sources, and from wetting and moisture absorption during entire construction period. Store the materials on pallets or platforms and cover the materials with waterproof tarpaulins. Store felt rolls on ends and, for a period of 24 hours prior to laying the felt, store it in an area maintained at a temperature greater than 49 degrees F (10 degrees C). Bundle tapered insulation board in accordance with the manufacturer's identity codes. Replace damaged material with new material.

1.05 ENVIRONMENTAL CONDITIONS

A. Do not install roof insulation during any form of precipitation, fog; or when air temperature is below 40 degrees F (4 degrees C) or if the air temperature is forecast to be less than 40 degrees F (4 degrees C) within 24 hours after installation; or when there is ice, frost, or other visible moisture on the roof deck.

1.06 PROTECTION OF PROPERTY

A. Flame-Heated Equipment: Do not place flame-heated equipment on the roof. Provide and maintain fire extinguishers of appropriate type and size near flame-heated equipment and on the roof.

B. Protective Coverings: Prior to starting work, install protective coverings at paving and building walls adjacent to the hoist and kettles. Lap protective coverings at least 6 inches (153 millimeters). Secure the coverings against wind and vent coverings to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

C. Special Protection: Provide approved special protection to avoid heavy traffic on completed work when ambient temperature is greater than 80 degrees F (27 degrees C).

D. Dripping of Bitumen: Seal joints in deck as necessary to prevent dripping of bitumen into building or down exterior walls.

PART 2 - PRODUCTS

2.01 ROOF INSULATION

A. One layer of the insulation shall be factory tapered to a slope of not less than 1/4 inch per foot (2.1 percent). Provide starter and filler blocks as required to provide the total thickness of insulation necessary to meet the specified slope and thermal conductance. Mitered joints shall be factory fabricated and shall consist of two diagonally cut boards or one board shaped to provide the required slopes. Identify each piece of tapered insulation board by color or other identity coding system, allowing the identification of different sizes of tapered insulation board required to complete the roof insulation system. Use one of, or an assembly of, a maximum of three of the following materials:

1. Polystyrene board: ASTM C578, Type II, IV, or X.
2. Polyurethane or polyisocyanurate board: ASTM C591, Type 1.
3. Cellular glass board: ASTM C552, Type IV.
4. Expanded perlite board: ASTM C728.
5. Felt faced polyurethane board: ASTM C1289, Type II, Class 1 or 2, Grade 2 or 3.
6. Composite board: ASTM C1289 Type III or Type VI.
7. Mineral fiberboard: ASTM C726, except the top surface of the insulation shall have an impact-resistant, factory-applied facing.
8. Wood fiberboard: ASTM C208.

B. Insulation Thickness: As necessary to provide a thermal conductance ("C" value) of 0.032 Btu/(square foot) (hr)/degree F or less for the average thickness of the tapered insulation system, except the thickness at the lowest point shall be a minimum of 1 1/2 inches (38 millimeters). Over steel decks, the insulation thickness shall satisfy both the specified "C" value and minimum thickness for the width of rib opening recommended in the insulation manufacturer's published literature.

C. Fire Safety Requirements: Tapered roof insulation, except for installation on poured-gypsum roof decks, poured-concrete roof decks or precast roof deck panels or planks which are listed in the FM P7825 as noncombustible roof deck construction, shall have a maximum flame spread rating of 75 and a minimum smoke developed rating of 150, exclusive of facing, when tested in accordance with ASTM E84. Insulation listed in the UL BMD Building Materials Directory and bearing the UL label will be accepted in lieu of copies of certified test reports. Compliance with flame-spread and smoke-developed ratings will not be required if the insulation has been tested as a part of a roof construction assembly of the type used for this project and the construction is UL listed as being fire-classified or listed as Class 1 roof deck construction in the FM P7825. Provide a thermal barrier of gypsum board or roof insulation in accordance with

the requirements of UL or the FM P7825. Insulation tested as a part of a roof construction assembly shall be provided with UL or FM labels attesting to the ratings specified herein.

2.02 PREFORMED CANTS AND TAPERED EDGE STRIPS

A. Provide the same material used for the roof insulation; or, if roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board, as recommended by the roofing manufacturer.

2.03 ASPHALT PRIMER

A. ASTM D41.

2.04 LOW-SLOPE ASPHALT:

A. ASTM D312, Type I or II.

2.05 STEEP ASPHALT:

A. ASTM D312, Type III or IV.

2.06 ASPHALT ROOF CEMENT:

A. ASTM D2822, Type I.

2.07 ROSIN-SIZED BUILDING PAPER OR UNSATURATED FELT

A. A minimum of 5 pounds (2.3 kilograms) per 100 square feet (9.3 square meters).

2.08 ASPHALT-SATURATED FELTS

A. ASTM D226, Type I.

2.09 ASPHALT-SATURATED FELT BASE SHEET

A. ASTM D2626.

2.10 NAILS AND FASTENERS

A. Flush-driven through discs or hexagonal plates a minimum of 1 3/8 inch (35 millimeters). Discs may be omitted when one-piece composite nails or fasteners with heads a minimum of one inch (25 millimeters) in diameter are used. Minimum withdrawal resistance of nails or approved fasteners shall be 40 pounds (178 newtons) each in the specific decks when driven, except for fasteners specified herein for steel decks.

B. Fasteners for Gypsum Decks: Self-clinching fasteners used in a pattern recommended by the manufacturer.

C. Fasteners for Lightweight Insulating Fill: Self-clinching fasteners.

D. Fasteners for Steel Decks: Hardened, penetrating-type fasteners with zinc-coated or chromate finish designed to be driven through the roof deck. Fasteners shall be FM listed for Class 1 roof deck construction. The length of fasteners shall be governed by the thickness of the insulation. Holding power shall be a minimum of 120 pounds per fastener or shall withstand an uplift pressure of 90 pounds per square foot (psf) (4,310 pascals) when tested in accordance with the uplift pressure test described in the FM D/S1-28 Loss Prevention Data Sheet 1-28.

2.11 DISCS AND PLATES

A. Steel or plastic. Discs used to secure insulation to steel decking shall be of the type and design listed in the FM for Class 1 roof deck construction or UL listed for fire-classified roof deck construction.

B. Steel Discs or Plates: Zinc coated steel not lighter than 28-gauge and a minimum of 3 inches (76 millimeters) in diameter. The disc or plate shall be formed to prevent dishing. Do not use bell- or cup-shaped caps.

C. Plastic Discs: High density molded thermoplastic with a smooth top surface, reinforcing ribs, and a minimum diameter of 3 inches (76 millimeters). Discs shall be designed to cause the fastener head to recess fully into the discs after driving.

PART 3 - EXECUTION

3.01 SURFACE CONDITION

A. Surface Inspection: Surfaces receiving vapor retarder and insulation shall be clean, smooth, and dry. Surfaces receiving vapor retarder shall also be free of projections which might puncture the vapor retarder.

B. Surface Preparation: Correct all deficiencies in roof deck surfaces including those at roof drains and outlets prior to the start of work. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex and are without stiffening grooves. Examine precast concrete decks to ensure that the joints between precast units are properly grouted and leveled to provide suitable surfaces for the installation of the vapor retarder and insulation.

3.02 INSTALLATION

A. Install roof insulating materials as specified herein unless specified or recommended otherwise by the manufacturer's printed instructions. Keep roof insulating materials dry before, during, and after installation. Keep insulation 1/2 inch (13 millimeters) clear of vertical surfaces penetrating and projecting from the roof surface.

B. Asphalt Temperature: When installing the vapor retarder and insulation, except polystyrene board, apply the asphalt when the temperature of the asphalt is within 25 degrees F (14 degrees C) of the EVT. Do not heat the asphalt to the FP. Do not heat asphalt above the FBT for longer than 4 consecutive hours. Use thermometers to check temperatures during heating and application. Have the kettle attended constantly during the heating process to ensure that specified temperatures are maintained.

C. Wood Nailers: Pressure-preservative treated wood nailers for securing insulation or for nailing of roofing felts are specified in Section 06 10 01, "Rough Carpentry." Except for uninsulated wood decks, verify prior to the installation of insulation that the nailers are the same thickness as the insulation and have been provided at eaves, edges, curbs, walls, and roof openings for securing cant strips, gravel stops, gutters, and flashing flanges.

D. Vapor Retarder: Install two plies of No. 15 asphalt-saturated felt or one layer of asphalt-saturated felt base sheet weighing a minimum of 35 pounds (16 kilograms) per 100 square feet (9.3 square meters) at right angles to the direction of the slope in direct contact with the roof deck surface. Install the first ply of felt or base sheet as specified herein for the specific deck. Solidly mop in place with steep asphalt the second ply of the two-ply vapor barrier system. Apply steep asphalt at the rate of at least 20 pounds (9 kilograms) per 100 square feet (9.3 square meters). Place the vapor retarder free of wrinkles or buckles. Press out air bubbles to obtain complete adhesion between surfaces. At walls, edges, and other vertical projections, extend the vapor retarder 6 inches (152 millimeters) to form a lap which shall later be wrapped around the edge of the insulation.

1. Vapor Retarder on Poured Concrete Decks: Solidly apply asphalt primer at the rate of one gallon (3.8 liters) per 100 square feet (9.3 square meters) of roof surface. Lay the first ply of the two-ply vapor retarder system with each sheet lapping 19 inches (483 millimeters) over the preceding sheet. Provide end laps a minimum of 4 inches (102 millimeters), and stagger the laps a minimum of 12 inches (305 millimeters). Cement felts together with a solid mopping of steep asphalt. For vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inches (102 millimeters) over the preceding sheet. Provide end laps not less than 4 inches (102

millimeters), and stagger the laps a minimum of 12 inches (305 millimeters). Cement base sheets together with a solid mopping of steep asphalt.

2. Vapor Retarder on Precast Concrete Decks: While solidly applying asphalt primer at the rate of one gallon (3.8 liters) per 100 square feet (9.3 square meters) of roof surface, prime and steep asphalt mop back approximately 4 inches (102 millimeters) from the joints between precast units. Place felt strips, 4 inches (102 millimeters) from the joints between precast units. Place felt strips, 4 inches (102 millimeters) or more in width, over joints 2 inches (51 millimeters) on each side in a cold-applied asphalt roof cement, and mop solidly before the vapor retarder is installed. Lay the first ply of the two-ply vapor retarder system with each sheet lapping 19 inches (483 millimeters) over the preceding sheet. Provide end laps a minimum of 4 inches (102 millimeters), and stagger the laps a minimum of 12 inches (305 millimeters). Cement felts together with a solid mopping of steep asphalt. For vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inches (102 millimeters) over the preceding sheet. Provide end laps not less than 4 inches (102 millimeters), and stagger laps a minimum of 12 inches (305 millimeters). Cement base sheets together with a solid mopping of steep asphalt.

3. Vapor Retarder on Gypsum Decks: Lay dry the first ply of two-ply vapor retarder system with each sheet lapping 2 inches (51 millimeters) over the preceding sheet. Provide end laps a minimum of 4 inches (102 millimeters), and stagger laps a minimum of 12 inches (305 millimeters). Fasten the portion of the felt in contact with gypsum deck with special self-clinching fasteners, and mop the width under the overlay. For a vapor retarder consisting of one layer of asphalt base sheet, lap each sheet 4 inches (102 millimeters) over the preceding sheet. Provide end laps a minimum of 4 inches (102 millimeters), and stagger laps a minimum of 12 inches (305 millimeters). Cement together the side and end laps with a solid mopping of steep asphalt or asphalt roof cement. Fasten the base sheet to the gypsum deck as specified herein for the two-ply vapor retarder system. Space fasteners in accordance with the recommendations of the roof insulation manufacturer.

E. Insulation: Install insulation over a vapor retarder which has been installed as specified herein directly to roof deck surface primed as specified herein for the specific deck. Lay insulation so that end joints of each course are staggered with those of the adjoining courses. When using multiple layers of insulation, the joints of each succeeding layer shall be parallel and staggered in both directions with respect to the layer below. Firmly embed the first layer of insulation and each succeeding layer of insulation in a solid steep asphalt mopping; mop only sufficient area to provide complete embedment of one board at a time. Except for the layer of insulation in contact with steel deck which shall be mechanically

fastened, use a minimum of 25 pounds (11 kilograms) of asphalt per 100 square feet (9.3 square meters) of roof deck for mopping each layer of insulation in place. On roof slopes where backnailing of roofing felts is required, provide pressure-preservative treated wood nailers. On projects where polystyrene insulation is provided, install the first layer of polystyrene insulation as specified herein for other types of insulation, except allow the steep asphalt applied to the substrate to cool to a temperature range of between 250 degrees F (121 degrees C) and 200 degrees F (93 degrees C), before embedding the polystyrene insulation. Install each succeeding layer of polystyrene with a low-slope asphalt that has been allowed to cool to a temperature range of between 200 degrees F (93 degrees C) to 175 degrees F (79 degrees C), and apply asphalt at a rate of 15 pounds (7 kilograms) per 100 square feet (9.3 square meters). While asphalt is still tacky, embed the next layer of polystyrene over the preceding layer with joints staggered at least 6 inches (152 millimeters). Each piece of insulation shall be walked-in prior to the installation of succeeding pieces of insulation.

1. Insulation on Poured Concrete Decks: Solidly apply asphalt primer at the rate of one gallon (3.8 liters) per 100 square feet (9.3 square meters) of roof surface.
2. Insulation on Precast Concrete Decks: While solidly applying asphalt primer at the rate of one gallon (3.8 liters) per 100 square feet (9.3 square meters) of roof surface, prime and steep asphalt mop back approximately 4 inches (102 millimeters) from the joints between precast units. Place felt strips, 4 inches (102 millimeters) or more in width, over the joints 2 inches (51 millimeters) on each side in a cold-applied asphalt roof cement, and mop solidly before the roof insulation is installed.
3. Insulation on Steel Deck: Secure insulation to the deck with piercing or self-drilling, self-tapping fasteners. Engage fasteners by driving them through insulation into the top flange of the steel deck. Insulation joints, parallel to the ribs of the deck, shall occur on solid bearing surfaces only, not over open ribs. When multiple layers of insulation are used, mop in the second layer and all succeeding layers as specified herein for mopping layers of insulation in place. Space fasteners as recommended in FM D/S1-28.
4. Insulation Over Top Surface of Polystyrene Board: On projects where polystyrene insulation is provided, install 1/2-inch (13-millimeter) thick wood fiberboard or 3/4-inch (19-millimeter) thick expanded perlite board over the top surface of the polystyrene board. Except where factory applied, adhere the overlayment board by solidly mopping the back side of the board with steep asphalt as specified herein for mopping layers of insulation in place, and while the steep asphalt temperature is between 200 degrees F (93 degrees C) and 225 degrees F (107 degrees C), flop the overlayment board into position. The joints of field applied overlayment board shall be tightly butted and staggered at least 6 inches (152 millimeters) with respect to the polystyrene board below them. Using a

taping machine or mop-and-flop method, apply 6-inch (152-millimeter) wide, 15-pound felt strips or glass fiber roofing tape centered over the joints and edges of the overlayment board.

5. Insulation for Polyurethane, Polyisocyanurate Board: Insulation Over Top Surface of Polyurethane and Polyisocyanurate Board: On projects where foam board roof insulation is provided, install 3/4-inch (19-millimeter) thick mineral fiberboard, wood fiberboard, or expanded perlite board over the top surface of the foam board. Adhere the overlayment board in a solid steep asphalt mopping as specified herein for the mopping layers of insulation in place. Stagger joints of the overlayment board at least 6 inches (152 millimeters) with respect to the foam board below them.

F. Cant Strips: Where indicated, provide cant strips at intersections of the roof with walls, parapets, and curbs extending above the roof. The face of cant strips shall have an incline of 45 degrees, the minimum face dimension shall be 5 1/2 inches (140 millimeters), and the minimum thickness shall be 1 1/2 inches (38 millimeters). Cant strips shall bear on the wood nailers and fit flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against nonnailable materials, install the cant strips in a heavy mopping of steep asphalt or set the cant strips in asphalt roof cement.

G. Tapered Edge Strips: Where indicated, provide edge strips in the right angle formed by the junction of the roof and wood nailing strips that extend above the level of the roof. Edge strips shall be tapered from the top of the wood nailing strips to approximately 1/8 inch (3 millimeters) at a slope of one to 1-1/2 inches per foot (8.4 to 13 percent). Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install edge strips in a heavy mopping of steep asphalt or set the edge strips in asphalt roof cement.

3.03 PROTECTION OF APPLIED INSULATION

Completely cover each day's installation of insulation with finished roofing specified. Do not permit phased construction. Protect the open ends of each day's work with temporary water cutoffs; remove the cutoffs when work is resumed. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, or platforms near roof structural supports, as necessary, to distribute weight to conform to the indicated live load limits of the roof construction.

END OF SECTION

SECTION 07 53 00

ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING SYSTEM (EPDM)

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Ethylene-Propylene-Diene-Monomer Roofing System (EPDM), as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES:

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publication:
      a. C136 - Sieve Analysis of Fine and Coarse Aggregates
   2. Factory Mutual Engineering and Research Corporation (FM) Publications:
      a. P7825 - Approval Guide - Equipment, Materials, Services for Conservation of Property
      b. D/S1-28 - Insulated Steel Deck, Loss Prevention Data Sheet
   3. Rubber Manufacturers Association (RMA) Publication:
      a. IPR1 - Minimum Requirements for Non-Reinforced Black EPDM Rubber Sheets for Use in Roofing Applications
   4. Underwriters Laboratories, Inc. (UL) Publications:
      a. 790 - Tests for Fire Resistance of Roof Covering Materials
      b. BMD - Building Materials Directory

1.03 SUBMITTALS

A. Submit the following.
   1. Manufacturer's Catalog Data:
      a. Elastomeric sheet
      b. Adhesive
      c. Water cutoff mastic
      d. Lap cleaner and sealant
      e. Flashing
      f. Flashing accessories
         1) Include materials' descriptions.
   2. Manufacturer's Instructions:
      a. Elastomeric sheet
      b. Adhesive
      c. Water cutoff mastic

d. Lap cleaner and sealant
e. Flashing
f. Flashing accessories
1) Include standard installation detail drawings where applicable.

3. Samples:
a. Fasteners
1) Submit 2 of each type of fastener.

4. Statements:
a. Applicator qualifications
1) Submit the elastomeric sheet roofing system manufacturer's written approval of the applicator.

5. Administrative or Closeout Submittals:
a. Roofer information card
1) Submit in accordance with the paragraph entitled "Information Card".

1.04 QUALIFICATION OF APPLICATOR

A. The roofing system applicator shall be approved by the elastomeric sheet roofing system manufacturer.

1.05 PRE-ROOFING CONFERENCE

A. Prior to starting the application of the roofing system and insulation, there will be a pre-roofing conference with the Engineer to ensure: (1) a clear understanding of drawings and specifications; (2) on-site inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system; and (3) coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing. The conference shall be attended by the Contractor; personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical work and electrical work; and the roofing materials manufacturer. Conflicts shall be resolved and confirmed in writing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials in their original, unopened containers or wrappings with labels intact and legible. Where materials are covered by a referenced specification number, the labels shall bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow continuity of work.

B. Storage: Store and protect materials from damage and weather in accordance with the manufacturer's instructions, except as specified otherwise. Keep materials clean and dry. Use pallets to support and canvas tarpaulins to

completely cover stored material. Do not use polyethylene as a covering. Locate materials temporarily stored on the roof in approved areas, and distribute the load to stay within the live load limits of the roof construction.

C. Handling: When hazardous materials are involved, adhere to the special precautions of the manufacturer. Adhesives contain petroleum distillates and are extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame. Do not use materials contaminated by exposure to moisture. Remove contaminated materials from the site.

1.07 ENVIRONMENTAL CONDITIONS

A. Do not install elastomeric sheet roofing during high winds or inclement weather, or when there is ice, frost, moisture, or visible dampness on the substrate surface. Unless recommended otherwise by the elastomeric sheet manufacturer, do not install elastomeric sheet when air temperature is below 10 degrees F (-12 degrees C) or within 5 degrees F (3 degrees C) of the dewpoint. When the air temperature is 40 degrees F (4 degrees C) or colder, use adhesives within 4 hours following exposure.

1.08 WARRANTY

A. Furnish the elastomeric sheet manufacturer's standard warranty for the elastomeric sheet roofing system. The warranty shall run directly to the Government. In no event shall the warranty period be less than 10 years from the date of the Government's acceptance of the work. The warranty shall provide that if within the warranty period the elastomeric sheet roofing system becomes non-watertight, splits, tears, or separates at the seams because of defective materials and workmanship, the repair or replacement of defective materials and correction of defective workmanship shall be the responsibility of the elastomeric sheet manufacturer. If the manufacturer or his approved applicator fails to perform repairs within 72 hours of notification, emergency repairs performed by others will not void the warranty.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Elastomeric Sheet: RMA IPR1. Ethylene Propylene Diene Monomer (EPDM), 0.06 inch (1.5 millimeter) minimum thickness for fully adhered application. Width and length of sheet shall be as recommended by the manufacturer.

B. Adhesive: As recommended by the elastomeric sheet manufacturer's printed data.

C. Water Cutoff Mastic, Lap Cleaner, and Sealant: As recommended by the elastomeric sheet manufacturer's printed data.

D. Flashing and Flashing Accessories: Flashing, including perimeter flashing, flashing around roof penetrations, and prefabricated pipe seals, shall be 0.06 inch (1.5 millimeter) minimum thick uncured neoprene or uncured elastomeric sheet, as recommended by the elastomeric sheet manufacturer's printed data.

E. Fasteners: As recommended by the elastomeric sheet manufacturer's printed data.

F. Roof Insulation Below Elastomeric Sheet: As specified in Section 07 22 16 "Roof Insulation" & Section 07 22 16.10 “Tapered Roof Insulation.

G. Fire Safety: The complete roof covering assembly shall have UL 790 Class A or B classification, be listed as fire-classified in the UL BMD, or listed as Class I roof deck construction in the FM P7825.

H. Windstorm Resistance: The complete roof covering assembly shall be capable of withstanding an uplift pressure of 60 pounds per square foot (414 kilopascals) when tested in accordance with the uplift pressure test described in the FM D/S1-28.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate work with that of other trades to ensure that components which are to be incorporated into the roofing system are available to prevent delays or interruptions as the work progresses. Examine substrates to which the roofing materials are to be applied to ensure that their condition is satisfactory for its application. Do not permit voids greater than 1/4 inch (6 millimeters) wide in the substrate. Concrete substrates shall be cured and free of laitance and curing compounds. Install wood blocking at perimeters, curbs, and penetrations. Substrates for roofing materials shall be dry and free of oil, dirt, grease, sharp edges, and debris. Inspect substrates, and correct defects before application of elastomeric sheets.

3.02 SPECIAL PRECAUTIONS

A. Do not dilute coatings or sealants unless specifically recommended by the materials manufacturer's printed application instructions. Do not thin liquid materials with cleaners used for cleaning elastomeric sheet.

B. Keep all liquids in airtight containers, and keep containers closed except when removing materials.

C. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 60 to 80 degrees F (15 to 26 degrees C) for at least 24 hours prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some elastomeric sheets and insulations; follow adhesive manufacturer's printed application instructions.

D. Do not allow contact between various materials through mixing of remains, dual use of mixing, transporting, or application equipment. Do not use equipment containing the remains of previous materials.

E. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.
   1. Do not use equipment with sharp edges which could puncture the elastomeric sheet.

3.03 WORK SEQUENCE

A. Arrange work to prevent use of newly constructed roofing for storage, walking surface, or equipment movement. If access is necessary, provide temporary walkways, platforms, or runways to protect new roofing surfaces and flashings from mechanical damage.

3.04 APPLICATION

A. Apply elastomeric sheet roofing in accordance with the elastomeric sheet manufacturer's application instructions and the following requirements.

B. Elastomeric Sheet Roofing: Unroll prefabricated elastomeric sheet roofing in position without stretching membrane. Lap sheets a minimum of 3 inches (75 millimeters). Inspect for holes. Remove sections of elastomeric sheet roofing that are creased or damaged, and allow sheets to relax at least 30 minutes before seaming.
   1. Fully Adhered Application: Apply adhesive evenly and continuously to substrate and underside of sheets at rates recommended by elastomeric sheet manufacturer's printed application instructions. Allow adhesive to dry to consistency prescribed by manufacturer before adhering sheets to the substrate. Roll each sheet into adhesive to avoid wrinkles; broom or roll to remove air pockets and "fishmouths" and to ensure full, continuous bonding of sheet to substrate. Clean both mating surfaces at splice area, apply adhesive, lap adjoining sheets, and seal seams according to instructions of elastomeric sheet manufacturer.

2. Perimeter Fastening: Mechanically secure the elastomeric sheet to nailers at roof perimeter and penetrations with specified fasteners. Space fasteners a maximum of 8 inches (203 millimeters) on centers, except as recommended otherwise by the elastomeric sheet manufacturer's printed data. Strip flash over the fasteners with a fully adhered layer of flashing material of the type recommended by the elastomeric sheet manufacturer's printed data.
3. Temporary Work: Install temporary cutoffs around incomplete edges of roofing assembly at the end of each day's work and when work must be postponed due to inclement weather. (Temporary cutoffs provide protection against moisture infiltration and absorption.) Straighten the insulation line using pieces of insulation loosely laid, and seal the elastomeric sheet membrane to the deck. Seal metal deck ribs as part of the cutoff. Remove the temporary seals completely when work resumes. Provide temporary ballast on the roofing as necessary to prevent wind damage to the elastomeric sheet.

C. Flashing: Install flashing as roofing sheets are installed in accordance with printed instructions of the elastomeric sheet manufacturer. Extend base flashing not less than 8 inches (203 millimeters) above roofing surface. Completely adhere flashing sheets in place. Use prefabricated pipe seals at pipe penetrations where possible.

3.05 ROOF DRAIN TEST

A. After the roofing system is complete but prior to Owner's acceptance of the roofing, perform the following test of roof drains and adjacent roofing for water tightness. Plug roof drains, and fill drains with water for 24 hours. To ensure some drainage from the roof, do not test all drains at the same time. Measure water levels at the beginning and end of the 24-hour period. If precipitation occurs during the test period, repeat the test. If the water level falls, remove water, thoroughly dry and inspect the installation, and repair or replace roofing at the drain. Repeat the test until there is no water leakage.

3.06 INFORMATION CARD

A. Provide a typewritten card, laminated in plastic and framed in a weather-tight frame, or a photo-engraved 0.032-inch (0.8-millimeter) thick aluminum card for each roof. This card shall be a minimum size of 8-1/2 by 11 inches (216 millimeters by 279 millimeters) and contain information listed in the attached Form 1. Install the card near access to the roof or where directed. Furnish framed card and a duplicate card to the Owner.

FORM 1

ELASTOMERIC SHEET ROOFING SYSTEM COMPONENTS

1. Contract Number:

2. Building Number & Location:

3. NAVFAC Specification Number:

4. Deck Type:

5. Slope of Deck:

6. Insulation Type & Thickness:

7. Insulation Manufacturer:

8. Vapor Retarder: [ ] Yes [ ] No

9. Vapor Retarder Type:

10. Sheet Elastomeric Roofing Description:
    Manufacturer (Name, address, & phone no.):
    Type:
    Method of attachment:
11. Statement of Compliance or Exception: _____

12. Date Roof Completed: _____

13. Warranty Period:

14. Roofing Contractor (Name & Address):

15. Prime Contractor (Name & Address):

Contractor's Signature: _____ Date:

Inspector's Signature: _____ Date:

END OF SECTION

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Flashing and Sheet Metal, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. B209 - Aluminum and Aluminum-Alloy Sheet and Plate
      b. B221 - Aluminum and Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube
      c. D41 - Asphalt Primer Used in Roofing, Dampproofing and Waterproofing
      d. D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
      e. D2822 - Asphalt Roof Cement
      f. D4022 - Coal Tar Roof Cement
   2. American Welding Society, Inc. (AWS) Publication:
      a. D1.2 - Structural Welding Code, Aluminum
   3. Federal Specifications (FS):
      a. QQ-L-201 - Lead Sheet
      b. UU-B-790 - Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)
   4. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Publication:
      a. ASMM - Architectural Sheet Metal Manual

1.03 SUBMITTALS

A. Submit the following.
   1. Drawings:
      a. Gutters and downspouts
      b. Building expansion joints
      c. Gravel stops and fascias
      d. Flashing for roof drains
      e. Base and cap flashing (counterflashing)
      f. Flashing at roof penetrations
      g. Reglets

h. Copings

1) Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.04 DELIVERY, HANDLING, AND STORAGE

A. Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weathertight, ventilated areas until immediately before installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Furnish sheet metal items in 8 to 10-foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Provide accessories and other items essential to complete the sheet metal installation. These accessories shall be made of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this Section. Sheet metal items shall have mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

B. Exposed Sheet Metal Items: Shall be of the same material. The following items shall be considered as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascias; cap, valley, steeped, base, and eave flashings and related accessories.

C. Lead Sheet: FS QQ-L-201, Grade B, minimum weight 4 pounds per square foot.

D. Aluminum Alloy Sheet and Plate: ASTM B209, form alloy, and temper appropriate for use, alloy 3003-H14 except allow used for color anodized aluminum shall be as required to produce specified color. Alloy required to produce specified color shall have the same structural properties as alloy 3003-H14.

1. Alclad: When fabricated of aluminum, the following items shall be fabricated of Alclad 3003, Alclad 3004, Alclad 3005, clad on one side, unless otherwise indicated.
   a. Gutters, downspouts, and hangers
   b. Gravel stops and fascias

c. Flashing.

2. Finish: Exposed exterior sheet metal items of aluminum shall have a baked-on, factory-applied color coating of polyvinylidene fluoride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Finish coating dry-film thickness shall be 0.8 to 1.3 mils, and color shall be as selected by Architect/Engineer from full range of color options.

E. Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes: ASTM B221.

F. Polyvinyl Chloride Reglet: ASTM D1784, Type II, 0.075 inch (1.9 mm) minimum thickness.

G. Bituminous Plastic Cement: ASTM D2822, Type I; ASTM D4022.

H. Building Paper: FS UU-B-790, Style 4, Grade B.

I. Asphalt Primer: ASTM D41.

J. Through-Wall Flashing: Through-wall flashing for masonry is specified in Section 04 20 01, "Unit Masonry".

K. Fasteners: Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

L. Scuppers: Fabricate scuppers with minimum of 100 mm (4 inch) wide flange. Provide flange at top on through wall scupper to extend to top of base flashing. Fabricate exterior wall side to project not less than 13 mm (1/2 inch) beyond face of wall with drip at bottom outlet edge. Fabricate not less than 100 mm (4 inch) wide flange to lap behind gravel stop fascia. Fabricate exterior wall flange for through wall scupper not less than 25 mm (one inch) wide on top and sides with edges hemmed. Fabricate gravel stop bar of 25 mm x 25 mm (one by one inch) angle strip soldered to bottom of scupper. Fabricate scupper not less than 200 mm (8 inch) wide and not less than 125 mm (5 inch) high for through wall scupper. Solder joints watertight.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Requirements: Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections which might affect the application. For installation of items not shown in detail or not covered by specifications, conform to the applicable requirements of SMACNA ASMM, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical

surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

B. Workmanship: Make lines, arrises, and angles sharp and true. Free exposed surfaces from visible wave, warp, and buckle, and tool marks. Fold back exposed edges neatly to form a 1/2-inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

C. Nailing: Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing or flashing to one edge only. Space nails evenly not over 3 inches on centers and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Sleepers and nailing strips are specified in Section 06 10 01, "Rough Carpentry".

D. Cleats: Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on centers unless otherwise specified or indicated. Unless otherwise specified, cleats shall be not less than 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Pre-tin cleats for soldered seams.

E. Loose-Lock Expansion Seams: Not less than 3 inches wide; provide minimum one-inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8-inch thick bed. Sealants are specified in Section 07 92 00, "Joint Sealants".

F. Welding and Mechanical Fastening: Use welding for aluminum of thickness greater than 0.040 inch. Aluminum 0.040 inch or less in thickness shall be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.
   1. Welding of Aluminum: Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2.
   2. Mechanical Fastening of Aluminum: Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 12 inches maximum on centers. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inches from the end of the overlapping sheet.

G. Protection from Contact with Dissimilar Materials:
   1. Aluminum: Aluminum surfaces shall not directly contact other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.
   2. Wood or Other Absorptive Materials: Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

H. Expansion and Contraction: Provide expansion and contraction joints at not more 32-foot intervals for aluminum and at not more than 40-foot intervals for other metals. Where the distance between the last expansion joint and the end of the continuous run is more than half the required interval, an additional joint shall be provided. Space joints evenly. Join extruded aluminum gravel stops and fascias by expansion and contraction joints spaced not more than 12 feet apart.

I. Base Flashing: Lay the base flashings with each course of the roof covering, shingle fashion, where practicable, where sloped roofs abut chimneys, curbs, walls, or other vertical surfaces. Extend up vertical surfaces of the flashing not less than 8 inches and not less than 4 inches under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inches. Overlap the flashing strips with the previously laid flashing not less than 3 inches. Fasten the strips at their upper edge to the deck, with compatible, large-head roofing nails. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of curbs, and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inches at the lower side of the roof decks. Install and fit the flashings so as to be completely weathertight. Base flashing for interior and exterior corners shall be factory-fabricated.

J. Counterflashing: Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths or may be of the preformed one-piece type. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12 inches from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inches apart; on short runs, place wedges closer together. Fill calked-type reglets or raked joints which receive counterflashing with calking compound. Calking is covered in Section 07 92 00, "Joint Sealants". Turn up the concealed

edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inches into the walls. Install counterflashing to provide a spring action against base flashing.

K. Metal Reglets: Calked type or friction type reglets shall be factory fabricated with a minimum opening of 1/4 inch and a depth of 1-1/4 inches, as approved.
   1. Calked Reglets: Provide with rounded edges and metal strap brackets or other anchors for securing to the concrete forms. Provide reglets with a core to protect them from injury during the installation. Provide built-up mitered corner pieces for internal and external angles. Wedge the flashing in the reglets with lead wedges every 18 inches, calked full and solid with an approved compound.
   2. Friction Reglets: Provide with flashing receiving slots not less than 5/8 inch deep, one-inch jointing tongues, and upper and lower anchoring flanges. Insert the flashing the full depth of the slot and lock by indentations made with a dull-pointed tool.

L. Polyvinyl Chloride Reglets: Rigid polyvinyl chloride reglets may be provided in lieu of metal reglets.

M. Gravel Stops and Roof Edge Fascias: Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascias after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inches long spaced not more than 3 inches on centers.
   1. Edge Strip: Hook the lower edge of fascias at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on centers. Where fastening is made to concrete or masonry, use screws spaced 12 inches on centers driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16-inch thick compatible spacer or washers.
   2. Joints: Leave open the section ends of gravel stops and fascias 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inches set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascias in accordance with the manufacturer's printed instructions and details.

N. Metal Drip Edge: Provide a metal drip, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 3

inches and secure with compatible nails spaced not more than 10 inches on center along upper edge.

O. Gutters: Field fabricate seamless gutters in manufacturer's standard shape, size as required. Provide gutters complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Aluminum gutters shall be joined with riveted sealed joints. Install gutters below slope line of the roof so that snow and ice can slide clear. Support gutters on adjustable hangers spaced not more than 30 inches on center or as recommended by the manufacturer. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals compatible with the gutters.

P. Downspouts: Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10-foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on centers with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

1. Terminations: Neatly fit into the drainage connection the downspouts terminating in drainage lines, and fill the joints with a Portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Concrete splash block is specified in Section 03 30 00, "Cast-In-Place Concrete". Provide splash pans as specified.

Q. Eave Flashing: One piece in width, applied in 8 to 10-foot lengths with expansion joints spaced as specified in paragraph entitled "Expansion and Contraction". Provide a 3/4-inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 10 inches on centers. Locate the upper edge of flashing not less than 18 inches from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with one-inch flat locked joints with cleats that are 10 inches on centers. Place eave flashing over underlayment and in plastic bituminous cement.

R. Expansion Joints: Provide expansion joints for roofs, walls, and floors where indicated and conform to the requirements of Table I.

1. Roof Expansion Joints: Consist of curb with wood nailing members on each side of joint. Provide counterflashing as specified in paragraph "Counterflashing", except as follows: Provide counterflashing with vertical leg of suitable depth to enable forming into a horizontal continuous cleat. Secure the inner edge to the nailing member. Make the outer edge projection not less than one inch for flashing on one side of the

expansion joint and be less than the width of the expansion joint plus one inch for flashing on the other side of the joint. Hook the expansion joint cover over the projecting outer edges of counterflashing. Provide roof joint with a joint cover of the width indicated. Hook and lock one edge of the joint cover over the shorter projecting flange of the continuous cleat, and the other edge hooked over and loose locked with the longer projecting flange. Joints are specified in Table II.

2. Floor and Wall Expansion Joints: Provide U-shape with extended flanges for expansion joints in concrete and masonry walls and in floor slabs.

S. Flashing at Roof Penetrations and Equipment Supports: Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

1. Single Pipe Vents: "See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 3 inches on centers. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4-inch roof flange in bituminous plastic cement and nailed 3 inches on centers. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant. Sealants are covered under Section 07 92 00, "Joint Sealants".

3.02 PAINTING

A. Field-paint sheet metal for separation of dissimilar materials.

3.03 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.04 REPAIRS TO FINISH

A. Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

TABLE I. SHEET METAL WEIGHTS AND THICKNESSES

Sheet Metal Items	Lead, Pounds Per Square Foot	Aluminum, Inch
Building Expansion Joints		
Cover	16	.032
Waterstop-bellows or flanged, U-type.	16	-
Downspouts and leaders	16	.032
Downspout clips and anchors	- -	.040 clip .125 anchor
Downspout straps, 2-inch	48(a)	.060
Flashings:		
Base	20	.040
Cap (Counter-flashing)	16	.032
Stepped	16	.032
Valley	16	.032
Roof drain	4	
Pipe vent sleeve (a)	2.5	
Coping	-	.040
Gravel stops and fascias		
Extrusions	.075	
Sheets, corrugated		.032
Sheets, smooth		.050
Edge strip		.050

Gutters:

Gutter section	.032
Continuous cleat	.032
Hangers, dimensions	1 inch x .080 inch
Joint Cover plates	.032

(a) 2.5-pound minimum lead sleeve with 4-inch flange. Where lead sleeve is impractical, refer to paragraph titled "Single Pipe Vents" for optional material.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Firestopping as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. American Society of Testing Materials (ASTM) Publications:
   1. E119 - Methods of Fire Tests of Building Construction and Materials
   2. E814 - Method of Fire Tests of Through-Penetration Fire Stops

B. Underwriters Laboratories, Inc. (UL) Publications:
   1. 263 - Fire Tests of Building Construction and Materials
   2. 1479 - Fire Tests of Through-Penetration Firestops
   3. 2079 - Standard for Safety Tests for Fire Resistance of Building Joint Systems

1.03 DESIGN REQUIREMENTS

A. Devices and materials shall meet the hourly fire resistance ratings required by the project as determined by UL 263, UL 1479, UL 2079, ASTM E119, or ASTM E814 and be listed and detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
   1. Exception: Where no listed designs exist that meet the requirements of a specific project condition, submit details and manufacturer's written recommendations for a design meeting the requirements. Include evidence of engineering judgement and extrapolation from listed designs.

1.04 SUBMITTALS

A. Submit the Firestop Schedule, Product Data, Samples and Quality Control Submittals specified below the same time as a package.

B. Firestop Schedule: Submit schedule itemizing the following:
   1. Manufacturer's product reference numbers and/or drawing numbers.
   2. UL, Inchcape Testing Services, Factory Mutual Research Corp., or Omega Point Lab design number.
   3. Location of firestop material.
   4. Penetrating Item Description/Limits: Material, size, insulated or uninsulated, and combustibility.

5. Maximum allowable annular space or maximum size opening.
6. Wall type construction.
7. Floor type construction.
8. Hourly Fire resistance rating of wall or floor.
9. F rating.
10. T rating.

C. Product Data: Catalog sheets, specifications and installation instructions for each firestop device and material.
1. Indicate design number for each firestop proposed to be used, and which is detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
2. State the specific locations where each firestop system is proposed to be installed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping materials to the site in original, new unopened containers or packages bearing manufacturer's printed labels.

B. Store and handle firestopping materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, etc.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:
1. Temperature: Do not install firestopping materials when ambient or substrate temperatures are outside limits permitted by manufacturer of firestopping materials.
2. Humidity and Moisture: Do not install the work of this Section under conditions that are detrimental to the application, curing, and performance of the materials.
3. Ventilation: Provide sufficient ventilation wherever firestopping materials are installed in enclosed spaces. Follow manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 FIRESTOPPING

A. Joint Treatment, Through-Penetration Firestop Devices, Forming Materials, And Fill, Void or Cavity Materials: As listed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
1. For firestopping exposed to moisture, furnish products that do not deteriorate when exposed to this condition.

2. For firestopping systems exposed to view, furnish products with flame-spread values
of less than 25 and smoke developed values less than 50, as determined per ASTM E84.
3. For penetrations for piping services below ambient temperature, furnish moisture-resistant through-penetration firestop systems.
4. For penetrations involving insulated piping, furnish through-penetration firestop systems not requiring removal of insulation.

B. Accessories: Components required to install fill materials as recommended by the firestopping manufacturer for particular approved fire rated system.

C. Identification Labels:
1. Furnished by fire stopping manufacturer of suitable material for permanent field identification of joint firestops and through-penetration firestops.
2. Identify the following:
a. "WARNING - FIRESTOP MATERIAL".
b. Company Name.
c. Product Catalog number.
d. F and T ratings.
3. Field fabricated labels are not acceptable.

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean out openings immediately before installation of through-penetration firestopping. Comply with recommendations of firestopping manufacturer and the following requirements:
1. Remove foreign materials from surfaces of openings, and from penetrating items that could interfere with adhesion of firestopping.
2. Clean opening and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form release agents from concrete.

B. Clean out openings, and juncture, control, and expansion joints immediately before installation of firestopping. Comply with recommendations of firestopping manufacturer and the following requirements:
1. Remove foreign materials from surfaces of openings and joint substrates, and from penetrating items that could interfere with adhesion of firestopping.
2. Clean opening joint substrates to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form release agents from concrete.

C. Protection:
1. Protect surfaces adjacent to through-penetration firestops with non-staining removable masking tape or other suitable covering to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of work and that would otherwise be permanently stained or damaged by such contact or that would be caused by cleaning methods used to remove smears from firestopping materials.

D. Substrate Priming:
1. Prime substrates in accordance with the firestopping manufacturer's printed installation instructions using recommended products and methods.
2. Do not allow primer to spill or migrate onto adjoining exposed surfaces.

3.02 INSTALLATION OF THROUGH PENETRATION FIRESTOPS

A. Use through-penetration firestop devices, forming materials, and fill, void or cavity materials to form through-penetration firestops to prevent the passage of flame, and limit temperature rise of the unexposed surface as detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory. Where applicable design is not detailed in the Directories, use forming materials and fill, void or cavity material to form through-penetration firestop in accordance with approved printed details and installation instructions from the company producing the forming materials and fill, void or cavity material.

B. Provide through-penetration firestop systems with F ratings which shall equal or exceed the fire resistance rating of the penetrated building construction.

C. Provide through-penetration firestop systems with T ratings, in addition to F ratings, at floors where the following conditions exist:
1. Where firestop systems protect penetrations located outside the wall cavities.
2. Where firestop systems protect penetrations located outside fire resistive shaft enclosures.

D. Firestop through-penetrations associated with the new work.

E. Firestop through-penetration of smoke partitions and fire rated assemblies.

F. Firestop through-penetrations of floors, walls, partitions, ceilings, and roofs in accordance with the fire resistance rating assigned to the walls, partitions, floors, ceilings, and roofs.

G. Permanently affix label at each firestop. Use adhesive compatible with surface construction at firestop location.

3.03 INSTALLATION OF JUNCTION, CONTROL, AND EXPANSION JOINT FIRESTOPS

A. Use joint treatment materials to form firestop to prevent the passage of flame and limit temperature rise of the unexposed surface, as detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide or the Omega Point Laboratories Listings Directory. Where applicable design is not detailed in the Directories, use forming materials and fill, void or cavity material to form firestop in accordance with approved printed details and installation instructions from the company producing the forming materials and fill, void or cavity material.

B. Firestop junctures association with the new work.

C. Firestop junctures, control joints, and expansion joints associated with smoke partitions and fire rated construction.

D. Permanently affix labels every 10 feet along each firestop. Use adhesive compatible with surface construction at firestop location.

3.04 CLEANING

A. Clean off excess fill materials and sealants adjacent to penetrations and joints by methods and cleaning materials recommended by manufacturers of firestopping products and of products in which penetrations occur.

B. Remove masking tape as soon as practical so as not to disturb the firestopping's bond with substrate.

C. Protect firestopping during and after curing period from contact with contaminating substances, or damage resulting from adjacent work.

D. Cut out and remove damaged or deteriorated firestopping immediately, and install new materials as specified in firestopping schedule.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Joint Sealants, as shown on the Plans, and/or as specified.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publication:
      a. C920 - Elastomeric Joint Sealants

1.03 SUBMITTALS

A. Submit the following.
   1. Manufacturer's Catalog Data:
      a. Sealants
      b. Primers
      c. Backstop materials
         1) Data for the sealants shall include shelf life, recommended cleaning solvents.

1.04 ENVIRONMENTAL CONDITIONS

A. The ambient temperature shall be within the limits of 40 and 100 degrees F when sealant is applied.

1.05 DELIVERY AND STORAGE

A. Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Elastomeric sealant containers shall be labeled to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 100 degrees F or less than 40 degrees F.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.
   1. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in the Section.

PART 2 - PRODUCTS

2.01 SEALANTS

A. Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

B. Interior Sealant: ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Location(s) of sealant shall be as follows:
   1. LOCATION
      a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.
      b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.
      c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.
      d. Joints between edge members for acoustical tile and adjoining vertical surfaces.
      e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.

C. Exterior Sealant: For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C920, Type S or M, Grade P, Class 25, Use T. Location(s) of sealant shall be as follows:
   1. LOCATION
      a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.
      b. Joints between new and existing exterior masonry walls.

c. Masonry joints where shelf angles occur.
d. Joints in wash surfaces of stonework.
e. Expansion and control joints.
f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.
g. Voids where items pass through exterior walls.
h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.
i. Metal-to-metal joints where sealant is indicated or specified.
j. Joints between ends of gravel stops, fascias, copings, and adjacent walls.

D. Floor Joint Sealant: ASTM C920, Type S or M, Grade P, Class 25, Use T. Location(s) of sealant shall be as follows:
1. LOCATION
a. Seats of metal thresholds for exterior doors.
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.

2.02 PRIMER FOR SEALANT

A. Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.03 BOND BREAKERS

A. Provide the type and consistency recommended by the sealant manufacturer for the particular application.

2.04 BACKSTOPS

A. Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.05 CLEANING SOLVENTS

A. Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

2.06 COLOR

A. Sealants exposed to view shall match the color of adjacent finished surfaces.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Surfaces shall be clean, dry to the touch, and free from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant.

B. Steel Surfaces: Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

C. Aluminum or Bronze Surfaces: Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.02 SEALANT PREPARATION

A. Do add liquids, solvents, or powders to the sealant. Mix multi-component elastomeric sealants in accordance with manufacturer's instructions.

3.03 APPLICATION:

A. Joint Width-To-Depth Ratios:
1. Acceptable Ratios:

JOINT WIDTH	**JOINT DEPTH**	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, Or stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch width	Equal to width
Over 1/2 inch to 2 inches	1/2 inch	5/8 inch
Over 2 inches	(As recommended by sealant manufacturer)	

2. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding shall not be required on metal surfaces.

B. Backstops: Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:
1. Where indicated.
2. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

C. Primer: Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

D. Bond Breaker: Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

E. Sealants: Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and cannot be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Sealant shall be uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified.

3.04 PROTECTION AND CLEANING

A. Protection: Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

B. Final Cleaning: Upon completion of sealant application, remove remaining smears and stains, and leave the work in a clean and neat condition.
1. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry, and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hours then remove by wire brushing or sanding.

2. Metal and Other Nonporous Surfaces: Remove excess sealant with a solvent-moistened cloth.

END OF SECTION

SECTION 08 11 13

METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Metal Doors and Frames, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. A526 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
      b. A591 - Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated
      c. C578 - Preformed, Cellular Polystyrene Thermal Insulation
      d. C591 - Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation
      e. D2863 - Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
   2. Door and Hardware Institute (DHI) Publications:
      a. A115.1 - Preparation for Mortise Locks for 1-3/8 Inch and 1-3/4-Inch Doors
      b. A115.2 - Preparation for Bored Locks for 1-3/4 Inch and 1-3/8-Inch Doors
      c. A115.4 - Preparation for Lever Extension Flush Bolts
      d. A115.5 - Preparation for 181 Series and 190 Series Deadlock Strikes
      e. A115.7 - Preparation for Floor Closers -- Light Duty, Center Hung, Single or Double Acting; Center Hung, Single or Double Acting; Offset Hung, Single Acting
      f. A115.12 - Preparation for Offset Intermediate Pivots
      g. A115.13 - Preparation for Tubular Deadlocks
      h. A115.14 - Preparation for Open Back Strikes
   3. Hollow Metal Manufacturers Association (HMMA) Publications:
      a. 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames
      b. 862 - Guide Specifications for Commercial Security Hollow Metal Doors and Frames

c. 863 - Guide Specifications for Detention Security Hollow Metal Doors and Frames
d. 865 - Guide Specifications for Swinging Sound Control Hollow Metal Doors and Frames

4. Military Specification (MIL):
   a. DOD-P-21035 - Paint, High Zinc Dust Content, Galvanizing Repair (Metric)
5. National Fire Protection Association (NFPA) Publications:
   a. 80 - Fire Doors and Windows
   b. 252 - Fire Tests of Door Assemblies
6. Underwriters Laboratories, Inc. (UL) Publication:
   a. 10B - Fire Tests of Door Assemblies

1.03 SUBMITTALS

A. Submit the following.

1. Manufacturer's Catalog Data:
   a. Doors
   b. Frames
   c. Accessories
      1) Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction.
2. Drawings:
   a. Steel doors
      1) Show elevations, construction details, metal gauges, hardware provisions, method of glazing, and installation details.
3. Schedules:
   a. Doors and frames
      1) Submit door and frame locations.

1.04 DELIVERY AND STORAGE

A. Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap welded frames in pairs, with one frame inverted, or provide temporary steel spreaders securely fastened to the bottom of each frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4-inch airspace between doors. Remove damp or wet packaging immediately, and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 - PRODUCTS

2.01 STANDARD STEEL DOORS

A. SDI 100, except as specified otherwise. Doors shall be either hollow steel construction or composite construction. Prepare doors to receive hardware specified in Section 08 71 00, "Door Hardware". Undercut doors where indicated. Exterior doors shall have top edge closed flush. Doors shall be 1-3/4 inches thick, unless otherwise indicated.

B. Door Grades:
1. Standard Duty Doors: HMMA 861, full flush seamless, of size(s) and design(s) indicated.
2. Heavy Duty Doors: HMMA 862, of size(s) and design(s) indicated. Provide where shown. Fill hollow steel exterior doors with mineral fiber insulation.

2.02 SHELVES, LOUVERS, ASTRAGALS, AND MOLDINGS:

A. Louvers: Louvers for interior doors or metal frames shall be stationary sight-proof type. Louvers for exterior doors shall be inverted Y type. Weld or tenon louver blades to frame and fasten the entire louver assembly to the door with moldings. Moldings on the room or non-security side of the door shall be detachable; moldings on the security side of the door shall be an integral part of the louver. Form louvers of 20-gauge steel for interior doors and panels and of 16-gauge steel for exterior doors and panels. Provide aluminum wire cloth, 18 by 18 or 18 by 16 mesh, for insect screens. Louvers, before screening, except louvers for lightproof door(s) and exterior door(s), shall have a minimum of 35 percent net-free opening. Louvers for lightproof doors shall have a minimum of 20 percent net-free opening. Louvers for exterior door(s) shall have a minimum of 30 percent net-free opening.

B. Astragals: For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00, "Door Hardware", provide overlapping steel astragals with the doors.

C. Moldings: Provide moldings around glass and louvers. Provide nonremovable moldings on the outside of exterior doors and on the corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to the stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.03 PLASTIC FOAM CORES

A. Rigid Polyurethane Foam: ASTM C591, Type 1 or 2, foamed-in-place or in board form, with an oxygen index of not less than 22 percent when tested in accordance with ASTM D2863; or

B. Rigid Polystyrene Foam Board: ASTM C578, Type I or II.

2.04 STANDARD STEEL FRAMES

A. HMMA Guide Specification shall match door as specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners. Provide steel frames for doors, transoms, sidelights, mullions, cased openings, and interior glazed panels, unless otherwise indicated.

B. Welded Frames: Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

C. Knock-Down Frames: Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

D. Mullions and Transom Bars: Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs butt welded thereto or knock-down for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

E. Stops and Beads: Form stops and beads from 20-gauge steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips-head self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on centers. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

F. Terminated Stops: Where indicated, terminate interior door frame stops 6 inches above floor.

G. Cased Openings: Fabricate frames for cased openings of same material, gauge, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

H. Anchors: Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gauge.
   1. Wall Anchors: Provide a minimum of three anchors for each jamb. Locate anchors opposite top and bottom hinges and midway between.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16-inch diameter steel wire, adjustable or T-shaped;
b. Stud Partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;
c. Completed Openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI 111F; and
d. Solid Plaster Partitions: Secure anchors solidly to back of frames and tie into the lath. Provide adjustable top strut anchors on each side of frame for fastening to structural members or ceiling construction above. Size and type of strut anchors shall be as recommended by the frame manufacturer.

2. Floor Anchors: Provide floor anchors drilled for 3/8-inch anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.05 FIRE DOORS AND FRAMES

A. NFPA 80 and this Specification. The requirements of NFPA 80 shall take precedence over details indicated or specified.

B. Labels: Fire doors and frames shall bear the label of Underwriters Laboratories, Inc. (UL), Factory Mutual Engineering Corporation (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

C. Oversized Doors: For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

D. Steel Astragal on Fire Doors: Astragal on pairs of labeled fire doors shall conform to NFPA 80 and UL requirements.

2.06 WEATHERSTRIPPING

A. As specified in Section 08 71 00, "Door Hardware".

B. Integral Gasket: Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals specified in Section 08 71 00, "Door Hardware". Insert gasket in groove after frame is finish painted.

2.07 HARDWARE PREPARATION

A. Reinforce, drill, and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI 107 and DHI A115.1, DHI A115.2, DHI A115.4. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI 100, as applicable. Punch door frames, with the exception of frames that will have weatherstripping or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.08 FINISHES

A. Factory-Primed Finish: Unless specified otherwise, phosphate treat and factory prime metal doors and frames as specified in SDI 100.

B. Hot-Dip Zinc-Coated and Factory-Primed Finish: Fabricate doors and frames from galvanized steel, ASTM A526, Coating Designation G60 or A60 (galvannealed). Repair damaged zinc-coated surfaces by the application of zinc dust paint conforming to DOD-P-21035. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI 100. Provide for all exterior doors

2.09 FABRICATION AND WORKMANSHIP

A. Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable.

B. Grouted Frames: For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Frames: Set frames in accordance with HMMA Guide Specifications. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing. Backfill frames with mortar. When an additive is provided in the mortar, coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, assure that stops are filled with rigid insulation before grout is placed.

B. Doors: Hang doors in accordance with clearances specified in HMMA Guide Specifications. After erection and glazing, clean and adjust hardware.

C. Fire Doors and Frames: Install fire doors and frames, including hardware, in accordance with NFPA 80.

3.02 PROTECTION

A. Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until all rust is removed, clean thoroughly, and apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.03 CLEANING

A. Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

END OF SECTION

SECTION 08 12 13

HOLLOW METAL FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Standard hollow metal frames.

B. Related Sections:
   1. Division 8 Section "Flush Wood Doors" for Doors in Hollow Metal Frames.
   2. Division 8 Section "Door Hardware" for door hardware for hollow metal doors.
   3. Division 9 Sections "Interior Painting" for field painting hollow metal doors and frames.

1.03 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.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. 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.

8. Details of moldings, removable stops, and glazing.

C. Other Action Submittals:
1. 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.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252. Retain first subparagraph below if applicable and acceptable to authorities having jurisdiction.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

1.06 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 nonvented plastic.
1. 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.
1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.08 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

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amweld Building Products, LLC.
   2. Benchmark; a division of Therma-Tru Corporation.
   3. Ceco Door Products; an Assa Abloy Group company.
   4. Curries Company; an Assa Abloy Group company.
   5. Deansteel Manufacturing Company, Inc.
   6. Firedoor Corporation.
   7. Fleming Door Products Ltd.; an Assa Abloy Group company.
   8. Habersham Metal Products Company.

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Frame Anchors: ASTM A591/A591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M, hot-dip galvanized according to ASTM A153/A153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A 153M.

E. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

F. Glazing: Comply with requirements in Division 8 Section "Glazing."

2.03 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet.
1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Wood Doors: 0.053-inch- thick steel sheet.
4. Frames for Borrowed Lights: 0.053-inch- thick steel sheet.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.04 FRAME ANCHORS

A. Jamb Anchors:
1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

2.05 STOPS AND MOLDINGS

A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

B. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.06 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 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. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and window Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

4. Jamb Anchors: Provide number and spacing of anchors as follows:
    a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
    b. Four anchors per jamb from 60 to 90 inches high.
    c. Compression Type: Not less than two anchors in each jamb.
5. 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.

D. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

E. 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 8 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 nontemplated, 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.

F. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.

2.07 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

3.01 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

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.

3.02 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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.03 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. Remove temporary braces necessary for installation only after frames have been properly set and secured.

e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

f. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. 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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal manufacturer's written instructions.

D. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.04 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. 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.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Flush Wood Doors, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES:

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. E90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
      b. E152 - Fire Tests of Door Assemblies
   2. Architectural Woodwork Institute (AWI) Publication:
      a. AWQS - Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program
   3. National Electrical Manufacturer's Association (NEMA) Publication:
      a. LD3 - High-Pressured Decorative Laminates
   4. National Fire Protection Association (NFPA) Publications:
      a. 80 - Fire Doors and Windows
      b. 252 - Fire Tests of Door Assemblies
   5. National Wood Window and Door Association (NWWDA) Publications:
      a. I.S. 1 - Wood Flush Doors
      b. I.S. 4 - Water-Repellent Preservative Treatment for Millwork
      c. TM-5 - Split Resistance
      d. TM-7 - Physical Endurance
      e. TM-8 - Hinge Loading Resistance
   6. Underwriters Laboratories, Inc. (UL) Publication:
      a. 10B - Fire Tests of Door Assemblies
   7. U.S. Department of Commerce Product Standard (PS):
      a. 32 - Hinged Interior Wood Door Units

1.03 SUBMITTALS

A. Shop Drawings: Submit drawings or catalog data showing each type of door unit; descriptive data of head and jamb weatherstripping with installation instructions shall be included. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly, door louvers, and glazing.

B. Manufacturer's Data: Submit the following:
   1. Recommended water-resistant sealer
   2. Sound transmission class rating
   3. Fire Resistance Rating

C. Color Selection Samples: Submit a minimum of three color samples for selection by the Engineer.

D. Certificates of Compliance: When labeling of each door as specified in paragraph "Marking" of this Section is not furnished, submit certificates indicating quality and construction of the door. The certification shall identify the standard on which the construction of the door was based, the standard under which preservative treatment, if used, was made; and which doors have a Type I glue bond.

E. Warranty: Submit a warranty to the Engineer that warrants all doors free of defects as set forth in the door manufacturer's standard door warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inches thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

1.05 WARRANTY

A. Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

PART 2 - PRODUCTS

2.01 DOORS

A. Provide doors of the types, sizes, and designs specified.

B. Interior Flush Doors: Provide solid wood/solid particle board core, Type II flush doors conforming to NWWDA I.S. 1 with faces of sound grade hardwood or hardboard (door veneer to match existing doors species, finish and veneer cut).

C. Fire Doors: Doors specified or indicated to have a fire rating shall conform to the requirements of UL 10B, ASTM E152, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating testing agency's name and approved hourly fire rating to hinge edge of each door.

2.02 ACCESSORIES

A. Door Louvers: Fabricate from wood and of sizes indicated. Louvers shall be of the manufacturer's standard design and shall transmit a minimum of 35 percent free air. Louvers shall be the slat type. Mount louvers in the door as indicated with flush wood moldings or wood lip moldings.

B. Door Light Openings: Provide glazed openings with the manufacturer's standard wood moldings except that moldings for doors to receive natural finish shall be of the same specie and color as the face veneers. Moldings on exterior doors shall have sloped surfaces. Moldings for flush doors shall be lip type. Provide glazed openings in fire-rated doors with fire rated frames. Glazing is specified in Section 08 80 00, "Glazing".

2.03 FABRICATION

A. Marking: Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door. The identifying mark, or a separate certification, shall identify the standard on which the construction of the door was based, identify the standard under which preservative treatment was made, and identify doors having a Type I glue bond.

B. Preservative Treatment: Exterior doors shall be water-repellent preservative treated and so marked at the plant in accordance with NWWDA I.S. 4.

C. Adhesives and Bonds: NWWDA I.S. 1. Use Type I bond for exterior doors and Type II bond for interior doors. Adhesive for doors to receive a natural finish shall be nonstaining.

D. Prefitting: At the Contractor's option, doors may be provided factory prefit. Doors shall be sized and machined at the factory by the door manufacturer in accordance with the standards under which they are produced. The work shall include sizing, beveling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules as required to coordinate the work.

E. Finishes:

1. Factory Finish: AWI AWQS System #3 Conversion varnish alkyd urea or System #4 Vinyl catalyzed. The coating shall be AWI AWQS premium, medium rubbed sheen, open grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish.
2. Plastic Laminate Finish: Factory applied, NEMA LD3, General or Specific purpose type, 0.050-inch minimum thickness. Glue laminated plastic for hollow core doors to wood veneer, plywood, or hardboard backing to form door panel. Combined minimum thickness of laminate sheet and backing shall be 0.10-inch.
3. Color: Provide color of finishes as indicated and/or as selected by the Engineer from manufacturer's standard color samples.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16-inch minimum, 1/8-inch maximum clearance at sides and top, and a 3/16-inch minimum, 1/4-inch maximum clearance over thresholds. Provide 3/8-inch minimum, 7/16-inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8-inch in 2 inches. Door warp shall not exceed 1/4-inch when measured in accordance with NWWDA I.S. 1.

B. Fire Doors: Install fire doors in accordance with NFPA 80. Do not paint over labels.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service doors.

B. Related Requirements:

1. Section 05 50 01 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.
2. Section 09 91 00 "Painting" for finish painting of factory-primed doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic-closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
6. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: **Two** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design"

2.3 DOOR ASSEMBLY

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

B. Acceptable Manufacturer: Overhead Door Corporation, 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.

C. Substitutions: An Approved Equal

D. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 3-1/4-inch center-to-center height.

1. Fenestrated Slats: Approximately 3- by 5/8-inch openings spaced approximately 1-1/2 inches apart and beginning 12 inches from jamb guides.
2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick fabricated from hot-dip galvanized steel and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Hood: Match curtain material and finish.

1. Shape: Round
2. Mounting: As indicated on Drawings.

J. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: outside only, with cylinder.

K. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Top of hood.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
4. Motor Exposure: Exterior, wet, and humid.
5. Motor Electrical Characteristics:
   a. Horsepower: 1 hp.
   b. Voltage: 208 V ac, three phase, 60 Hz, coordinate with electrical specifications.
6. Emergency Manual Operation: Crank type.

7. Obstruction-Detection Device: Automatic photoelectric sensor electric sensor edge on bottom bar.
    a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
8. Control Station(s): Interior mounted Exterior mounted Where indicated on Drawings
9. Other Equipment: Portable radio-control system.

L. Curtain Accessories: Equip door with automatic-closing device.

M. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Factory Prime Finish: Manufacturer's standard color.

2.4 MATERIALS, GENERAL

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.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
2. Stainless Steel Door Curtain Slats: ASTM A240/A240M or ASTM A666, Type 304; sheet thickness of 0.025 inch; and as required.
3. Aluminum Door Curtain Slats: ASTM B209 sheet or ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
4. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection-rated glass as required for type of door; set in glazing channel secured to curtain slats.
5. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
6. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.
7. Plastic Interior Curtain-Slat Facing: Extruded PVC plastic with maximum flame-spread index of [**25**] [**75**] [**200**] and smoke-developed index of 450, according to ASTM E84 or UL 723.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.
2. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: standard with manufacturer and keyed to building keying system.
2. Keys: Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Pole Hooks: Provide pole hooks and poles for doors more than 84 inches high.

B. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor-operated doors allows testing without mechanical release of the door. Automatic-closing device is to be designed for activation by the following:

1. Replaceable fusible links with temperature rise and melting point of 165 deg F interconnected and mounted on both sides of door opening.
2. Manufacturer's standard UL-labeled smoke detector and door-holder-release devices.
3. Manufacturer's standard UL-labeled heat detector and door-holder-release devices.
4. Building fire-detection, smoke-detection, and -alarm systems.

2.9 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall-mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.
5. Through-Wall Mounted: Operator is mounted on other side of wall from coil side of door.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
    a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.
2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

L. Portable Radio-Control System: Consisting of two of the following per door operator:

1. Three-channel universal coaxial receiver to open, close, and stop door.
2. Portable control device to open and stop door may be momentary-contact type; control to close door is to be sustained- or constant-pressure type.
3. Remote-antenna mounting kit.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

D. Fire-Rated Doors: Install according to NFPA 80.

E. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

F. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

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

END OF SECTION

SECTION 08 41 13

ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnaich all labor, materials and equipment for Aluminum Framed Entrances and Storefronts, as shown on the Plans, as specified, and/or directed.

B. Glass: Reference Section 08 80 00, “Glazing”.

C. Single Source Requirement: All products shall be by the same manufacturer.

1.02 REFERENCES

A. The publications identified herein and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.03 PRODUCT QUALITY AND COMPATIBILITY

A. Coordinate all Division 08 products to ensure consistent product quality and compatability for a fully operting system.

1.04 LABORATORY TESTING AND PERFORMANCE REQUIREMENTS

A. Test Units:
   1. Air, water, and structural test unit size shall be a minimum of two stories high and three lites wide.
   2. Thermal test unit sizes shall be 80" (2032 mm) wide x 80" (2032 mm) high with one intermediate vertical mullion and two lites of glass.

B. Test Procedures and Performance:
   1. Air Infiltration Test:
      a. Test unit in accordance with ASTM E283 at a static air pressure difference of 6.24 psf (299 Pa).
      b. Air infiltration shall not exceed .06 cfm/SF (.30 l/s•m²) of unit.

2. Water Resistance Test:
   a. Test unit in accordance with ASTM E331.
   b. There shall be no uncontrolled water leakage at a static test pressure of 12.0 psf (575 Pa).
3. Uniform Load Deflection Test:
   a. Test in accordance with ASTM E330.
   b. Deflection under design load shall not exceed L/175 of the clear span.
4. Uniform Load Structural Test:
   a. Test in accordance with ASTM E330 at a pressure 1.5 times the design wind pressure in 1.05.B.3.b.
   b. At conclusion of the test, there shall be no glass breakage, permanent damage to fasteners, storefront parts, or any other damage that would cause the storefront to be defective.
5. Condensation Resistance Test (CRF):
   a. Test unit in accordance with AAMA 1503.1.
   b. Condensation Resistance Factor (CRF) shall not be less than 56 (frame) when glazed with .29 center of glass U-Factor. (See chart at end of section).
6. Condensation Resistance (CR):
   a. With ventilators closed and locked, test unit in accordance with NFRC 500-2010.
   b. Condensation Resistance (CR) shall not be less than 37when glazed with .29 center of glass U-Factor. (See chart at end of section).
7. Thermal Transmittance Test (Conductive U-Factor):
   a. With ventilators closed and locked, test unit in accordance with NFRC 100-2010.
   b. Conductive thermal transmittance (U-Factor) shall not be more than .41 BTU/hr•ft^2•°F.
      (2.33 W/m^2•K) when glazed with .29 center of glass U-Factor. (See chart at end of section.)

Glass Comparison Chart				
Glass	**C.O.G.[2] U-Factor**	**U-Factor[1]**	**Frame CRF[3]**	**CR[1]**
1" IG	0.47	0.56 BTU/hr•ft²•°F (3.18 W/m²•K)	56	36
1" IG	0.29	0.41 BTU/hr•ft²•°F (2.33 W/m²•K)	56	37
1" IG	0.24	0.37 BTU/hr•ft²•°F (2.10 W/m²•K)	56	37

[1]U-Factor and Condensation Resistance (CR) are based on a nominal size of 47.25" (1200 mm) x 59" (1500 mm) with two lites of glass using NFRC-100, and 500 - 2010
[2]Intercept® Spacer
[3]Based on AAMA 1503.1

C. Project Wind Loads: The system shall be designed to withstand the following loads normal to the plane of the wall:
   1. Positive pressure of 30 psf at non-corner zones.
   2. Negative pressure of 30 psf at non-corner zones.
   3. Negative pressure of 30 psf at corner zones.

1.05 FIELD TESTING AND PERFORMANCE REQUIREMENTS

A. Test in accordance with AAMA 501.2 for spray test only or AAMA 503.92 for pressurized test.

1.06 QUALITY ASSURANCE

A. Provide test reports from AAMA accredited laboratories certifying the performance as specified in 1.6.

B. Test reports shall be accompanied by the storefront manufacturer's letter of certification stating that the tested storefront meets or exceeds the referenced criteria for the appropriate storefront type.

1.07 SUBMITTALS

A. Contractor shall submit shop drawings; finish samples, test reports, and warranties.
   1. Samples of materials as may be requested without cost to Owner, i.e., metal, glass, fasteners, anchors, frame sections, mullion section, corner section, etc.

B. An NFRC Component Modeling Approach (CMA) generated label certificate shall be provided by the manufacturer. The label certificate shall be project specific and will contain the thermal performance ratings of the manufacturer's framing combined with the specified glass, and the glass spacer used in the fabrication of the glass, at NFRC standard test size as defined in table 4-3 in NFRC 100-2010.

1.08 WARRANTIES

A. Total Storefront Installation:
   1. The responsible Contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total storefront installation. This includes the glass (including insulated units), glazing, anchorage and setting system, sealing, flashing, etc., as it relates to air, water and structural adequacy as called for in the specifications and approved shop drawings.
   2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible Contractor at their expense during the warranty period.

B. Window Material and Workmanship: Provide written guarantee against defects in material and workmanship for 3 years from the date of final shipment.

C. Glass:
   1. Provide written warranty for insulated glass units that they will be free from obstruction of vision as a result of dust or film formation on the internal glass surfaces caused by failure of the hermetic seal due to defects in material and workmanship.
   2. Warranty period shall be for 10 (ten) years.

D. Finish: Warranty period shall be for 3 years from the date of final shipment. Provide clear anodized finish.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aluminum: Extruded aluminum shall be 6063-T6 alloy and temper.

B. Glass: Ship open for 1" Insulated glass with a center of glass U-Factor of .29 constructed as shown on the drawings.

C. Thermal Barrier:
1. All exterior aluminum shall be separated from interior aluminum by a rigid, structural thermal barrier. For purposes of this specification, a structural thermal barrier is defined as a system that shall transfer shear during bending and, therefore, promote composite action between the exterior and interior extrusions.
2. Barrier material shall be poured-in-place, two-part polyurethane. A nonstructural thermal barrier is unacceptable.

2.02 FABRICATION

A. General:
1. All aluminum frame extrusions shall have a minimum wall thickness of .080" (2 mm).
2. All exposed work shall be carefully matched to produce continuity of line and design with all joints. System design shall be such that raw edges will not be visible at joints.

B. Frame:
1. Depth of frame shall not be less than 4 1/2" (114 mm).
2. Face dimension shall not be less than 2" (50 mm).
3. Frame components shall be screw spline construction.

C. Glazing: Comply with Division 08 Section “Glazing.”
1. Glazing: All units shall be “dry glazed" with gaskets on both exterior and interior of the glass.
2. Glazing Gaskets: Manufacturer’s standard sealed-corner pressure glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
3. Glazing Sealants: As recommended by manufacturer.
4. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.
a. Color: Match structural sealant.

D. Finish:
1. Anodic : Finish all exposed areas of aluminum windows and components with electrolytically deposited color in accordance with Aluminum Association Designation AA-M10-C22-A41.

AA Description	Description	Arch. Class	AAMA Guide Spec.
AA-M10-C22-A41	Clear Anodized	1	611-98

2. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
    a. Color and Gloss: As selected by Engineer/Owner from manufacturer's full range of finish options to match existing.

E. Entrance Door Systems:
1. Entrance Doors: Manufacturer's standard glazed entrance doors for manual swing operation.
    a. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically festen corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Thermal Construction: High performance plastic connectors separate aluminum members exposed to tge exterior from members exposed to the interior.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
    a. Provide nonremovable glazing stops on outside of door.

F. Entrance Door Hardware:
1. Entrance Door Hardware: Hardware not specified in this Section is specified in Division 08 Section "Door Hardware."

PART 3 - EXECUTION

3.01 INSPECTION

A. Job Conditions: All openings shall be prepared by others to the proper size and shall be plumb, level and in the proper location and alignment as shown on the architect's drawings.

3.02 INSTALLATION

A. Use only skilled tradesmen with work done in accordance with approved shop drawings and specifications.

B. Storefront system shall be erected plumb and true, in proper alignment and relation to established lines and grades.

C. Entrance doors shall be securely anchored in place to a straight, plumb and level condition, without distortion. Weather stripping contact and hardware movement shall be checked and final adjustments made for proper operation and performance of units.

D. Furnish and apply sealing materials to provide a weather tight installation at all joints and intersections and at opening perimeters.

E. Sealing materials specified shall be used in strict accordance with the manufacturer‘s printed instructions, and shall be applied only by mechanics specially trained or experienced in their use. All surfaces must be clean and free of foreign matter before applying sealing materials. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

3.03 ANCHORAGE

A. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.

3.04 PROTECTION AND CLEANING

A. The General Contractor shall protect the aluminum materials and finish against damage from construction activities and harmful substances. The General Contractor shall remove any protective coatings as directed by the Architect, and shall clean the aluminum surfaces as recommended for the type of finish applied.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Door Hardware, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Builders Hardware Manufacturers Association, Inc. (BHMA) Publications:
      a. 101 - Butts and Hinges (ANSI/BHMA A156.1)
      b. 111 - Template Hinge Dimensions (ANSI/BHMA A156.7)
      c. 301 - Door Controls - Closers (ANSI/BHMA A156.4)
      d. 311 - Door Controls - Overhead Holders (ANSI/BHMA A156.8)
      e. 321 - Life Safety Closer/Holder/Release Devices (ANSI/BHMA A156.15)
      f. 501 - Auxiliary Locks and Associated Products (ANSI/BHMA A156.5)
      g. 601 - Bored and Preassembled Locks and Latches (ANSI/BHMA A156.2)
      h. 621 - Mortise Locks and Latches (ANSI/BHMA A156.13)
      i. 701 - Exit Devices (ANSI/BHMA A156.3)
      j. 1001 - Architectural Door Trim (ANSI/BHMA A156.6)
      k. 1101 - Self-Closing Hinges and Pivots (ANSI/BHMA A156.17)
      l. 1201 - Auxiliary Hardware (ANSI/BHMA A156.16)
      m. 1301 - Materials and Finishes (ANSI/BHMA A156.18)
   2. Federal Specifications (FS):
      a. FF-P-101 - Padlock
      b. FF-P-110 - Padlock, Changeable Combination (Resistant to Opening by Manipulation and Surreptitious Attack)
   3. National Fire Protection Association (NFPA) Publications:
      a. 80 - Fire Doors and Windows
      b. 101 - Life Safety Code
   4. Steel Door Institute (SDI) Publication:
      a. 100 - Standard Steel Doors and Frames
   5. Underwriters Laboratories, Inc. (UL) Publications:
      a. BMD - Building Materials Directory, January

b. 14C - Swinging Hardware for Standard Tin-Clad Fire Doors Mounted Singly and in Pairs

1.03 SUBMITTALS

A. Submit the following.
1. Design Data:
a. Keying system
1) Submit keying system for approval by the Owner/Engineer.

2. Manufacturer's Catalog Data:
a. Door hardware
1) Submit for each different item of hardware.
3. Schedules:
a. Hardware list
b. Hardware schedule
1) Hardware List: Submit in the following form:

Hardware Item	Reference Publication Type No.	Mfr. Name and Catalog No.	UL Mark (If fire rated and listed)	BHMA Finish Designation

4. Hardware Schedule: Submit to the Engineer. Include for each item the quantity, manufacturer's catalog number, corresponding reference publication type number, size, finish, key control symbols, and UL mark if fire rated and listed. Indicate that each item listed under the paragraph entitled "Hardware Items" meets the standard listed for that item. A copy of the listing of proposed hardware items in the current applicable BHMA directories of certified products may be submitted in lieu of test reports.

1.04 DELIVERY AND MARKING

A. Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with manufacturer's name and catalog number as shown in hardware schedule.

PART 2 - PRODUCTS

2.01 HARDWARE MANUFACTURERS AND MODIFICATIONS

A. Provide, as far as practicable, locks, hinges, pivots, and closers of one lock, hinge, pivot, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

2.02 HARDWARE DESIGNATIONS

A. Hardware items covered by BHMA standards are specified by BHMA designations. Items covered by Federal Specifications are specified by Federal Designations.

2.03 TEMPLATE HARDWARE

A. Hardware to be applied to metal or to prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to BHMA 111. Coordinate hardware items to prevent interference with other hardware.

2.04 HARDWARE FOR FIRE DOORS AND EXIT DOORS

A. NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements specified. Swinging hardware for tin-clad fire doors shall conform to UL 14C. Such hardware shall bear the UL label and be listed in UL BMD for class of door required.

2.05 HARDWARE ITEMS

A. Conform to the respective standards listed and to requirements specified herein. Hinges, pivots, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover. Provide hardware items as specified below and as listed under "Hardware Sets".

B. Hinges: BHMA 101, 4-1/2 by 4-1/2 inches unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

C. Pivots: BHMA 301.

D. Spring Hinges: BHMA 1101.

E. Locks and Latches: BHMA 621, Series 1000, Operational Grade 1, Security Grade 1. Provide mortise locks with escutcheons not less than 7 by 2-1/4 inches with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Knobs and roses of mortise locks shall have screwless shanks and no exposed screws. BHMA 601, Series 4000, Grade 2. Locks for exterior doors shall have threaded roses or concealed machine screws.

F. Auxiliary Locks: BHMA 501, Grade 1.

G. Exit Devices: Exit Devices (Panic Hardware or Fire Exit Hardware) and Auxiliary Items: BHMA 701, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Touch bars may be provided in lieu of conventional cross bars and arms. Provide escutcheons, not less than 7 by 2-1/4 inches. Cut escutcheons to suit cylinders and operating trim.

H. Lock Cylinders: Provide cylinders for new locks, including locks provided under other sections of this Specification. Cylinders shall have six pin tumblers and shall be products of the same manufacturer. Cylinders shall have interchangeable cores which are removable by a special control key. Provide a great master keying system. Provide a construction master keying system.

I. Lock Trim: Cast, forged, or heavy wrought construction and commercial plain design. In addition to meeting the test requirements of BHMA 601 and BHMA 621, knobs, roses, and escutcheons shall be 0.050 inch thick if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch, except that knob shanks shall be 0.060 inch thick.

J. Keys: Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system; furnish one additional working key for each lock of each keyed-alike group.

K. Door Bolts: BHMA 1201. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA 701, Type 25.

1. Closers: BHMA 301, Series C02000, Grade 1, with optional feature (o.f.) PT 4C, unless otherwise specified. Provide closers complete with brackets, arms, mounting devices, fasteners, pivots, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations and list sizes in the Hardware Schedule.
    a. Identification Marking: In addition to the manufacturer's name or trademark, each closer shall bear the manufacturer's size designation where it will be visible after installation.
    b. Special Tools: Provide special tools for adjustment of door closing devices, such as spanner and socket wrenches.

L. Door Release Plates: Door Pulls, Push Plates and Kickplates: BHMA 1001.
   1. Sizes of Kickplates: Width for single doors shall be 2 inches less than door width; width for pairs of doors shall be 1 inch less than door width. Height of kickplates shall be 10 inches for flush doors.

M. Edge Guards: BHMA 1001, stainless steel, of same height as armor plates.

N. Door Stops and Silencers: BHMA 1201. Silencers Type L03011. Provide one silencer for each hole punched in hollow metal frames.

O. Thresholds: BHMA 701, Type 26, with vinyl or silicone rubber insert in face of stop, and BHMA 1001.

P. Weatherstripping: A set shall include head and jamb seals. Weatherstripping shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be clear (natural) anodized. Fasten weatherstripping in place with color-matched sheet metal screws not more than 9 inches o.c. after doors and frames have been finish painted.

Q. Soundproofing: A set shall include adjustable doorstops at head and jambs and an automatic door bottom, both of extruded aluminum, clear (natural) anodized, surface applied, with vinyl fin seals between plunger and housing. Doorstops shall have solid neoprene tube, silicone rubber, or closed-cell sponge gasket. Door bottoms shall have adjustable operating rod and silicone rubber or closed-cell sponge neoprene gasket. Doorstops shall be mitered at corners. Zero "Sound Stop 1" (#770 and #361); Pemko #350ASN and #430AS; National Guard #1038N and #420, or approved equal.

R. Special Tools: Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.06 FASTENERS

A. Furnish fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Use fasteners of type necessary to accomplish a permanent installation. Use full-threaded wood screws.

2.07 FINISHES

A. BHMA 1301. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have aluminum paint finish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated) BHMA 600 finish (primed for painting). Exit devices may be provided in BHMA 626 finish in lieu

of BHMA 630 finish except where BHMA 630 is specified under "Hardware Sets". Exposed parts of concealed closers shall have finish to match lock and door trim. Hardware for aluminum doors shall be finished to match the doors.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Use machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Use toggle bolts where required for fastening to hollow core construction. Use through bolts where necessary for satisfactory installation.

3.02 ACCEPTANCE OF WORK

A. After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that the testing can be witnessed. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.03 FIRE DOORS AND EXIT DOORS

A. Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors, and UL 14C for swinging tin-clad fire doors.

3.04 HARDWARE LOCATIONS

A. SDI 100, unless indicated or specified otherwise.

1. Kick and Armor Plates: Push side of single-acting doors.
   Both sides of double-acting doors.

3.05 HARDWARE SETS

A. Hardware sets should be provided as specified below, or approved equal. Finishes to be selected by Owner from manufacturer's full range of finish options.

HW-1 (Entrance Set) Double Exterior Door (Aluminum)

1 Key Cylinder	Premium Core (Best Access Brand)

HW-2 (Entrance Set) Single Exterior Door (Aluminum) (Add Bid Item No. 2)

Key Fob reader unlocks lockset. Outside lever always locked with power applied to solenoid. Unlocks by key fob reader or remote control, loss of power*, or fire alarm activation. Key fob reader, electric strike, power sully and remote control as per electrical specifications.

1 Panic Device	Precision 2100 – Rim Device (Exit/Panic Device) with 4900A "A" Lever Trim (Precision APEX Brand)
1 Closers	Stanley D4550 Series Heavy Duty Door Closer with cover (Stanley Brand)
1 Hinge	McKinney Full Mortise Continuous Hinges FM-2000 (780-112HD) (MCK Brand)
1 Weatherstripping	Pemko 305CR
1 Soundproofing Gasket	Pemko Door Bottom Neoprene Sweep (315)
1 Threshold	Pemko Commercial Door Saddle Threshold (252x4SSFG) (Assa Abloy) thermally broken ADA saddle

HW-3 (Entrance Set) Single Exterior Door (Hollow Metal)

1 Panic Device	Precision 2100 – Rim Device (Exit/Panic Device) with 4900A "A" Lever Trim (Precision APEX Brand)

HW-4 (Entrance Set) Single Exterior Door (Hollow Metal) (Access Control Each Side)

Key Fob reader unlocks lockset. Outside lever always locked with power applied to solenoid. Unlocks by key fob reader or remote control, loss of power*, or fire alarm activation. Key fob reader, electric strike, power sully and remote control as per electrical specifications.

1 Each Lockset	9K Series Commercial Grade Door Lock Mortise Lever #15D ADA Compliant (Best Access Brand)
1 Each Closer	Stanley D4550 Series Heavy Duty Door Closer with cover (Stanley Brand)
3 Each Hinges	PBB 4B81 Commercial Grade Heavy Duty Weight Ball Bearing Hinge (PBB Brand)
1 Weatherstripping	Pemko 305CR
1 Soundproofing Gaskets	Pemko Door Bottom Neoprene Sweep (315)
1 Threshold	Pemko Commercial Door Saddle Threshold (252x4SSFG) (Assa Abloy) thermally broken ADA saddle

HW-5 (Classroom Set) Single Interior Door (Wood)

1 Each Lockset	9K Series Commercial Grade Door Lock Mortise Lever #15D ADA Compliant (Best Access Brand)

HW-6 (Classroom Set) Single Interior Door (Wood)

3 Hinges	PBB 4B81 Commercial Grade Heavy Duty Weight Ball Bearing Hinge (PBB Brand)
1 Each Lockset	9K Series Commercial Grade Door Lock Mortise Lever #15D ADA Compliant (Best Access Brand)
1 Each Closer	Stanley D4550 Series Heavy Duty Door Closer with cover (Stanley Brand)
3 Silencers	DCI 307D Metal Frame Door Silencers (DCI Brand)
1 Each Wall/Hinge Stops	(Wall) DCI Concave Wall Mounted Door Stop/(Hinge) DCI Pin Door Stop (DCI Brand)
1 Threshold	Pemko Door Saddle Threshold (272) (Assa Abloy)

HW-7 (Classroom Set) Single Interior Door (Wood)

Key Fob reader unlocks lockset. Outside lever always locked with power applied to solenoid. Unlocks by key fob reader or remote control, loss of power*, or fire alarm activation. Key fob reader, electric strike, power sully and remote control as per electrical specifications.

3 Hinges	PBB 4B81 Commercial Grade Heavy Duty Weight Ball Bearing Hinge (PBB Brand)
1 Each Lockset	9K Series Commercial Grade Door Lock Mortise Lever #15D ADA Compliant (Best Access Brand)
1 Each Closer	Stanley D4550 Series Heavy Duty Door Closer with cover (Stanley Brand)
3 Silencers	DCI 307D Metal Frame Door Silencers (DCI Brand)
1 Each Wall/Hinge Stops	(Wall) DCI Concave Wall Mounted Door Stop/(Hinge) DCI Pin Door Stop (DCI Brand)
1 Threshold	Pemko Door Saddle Threshold (272) (Assa Abloy)

HW-8 (Passage Set) Double Interior Door (Wood)

2 Track	BP250N-01-60 Aluminum Track (Best Brand)
1 Fascia	BP250N-02-60 Aluminum Fascia (Best Brand)
4 Hangers	BP150N-41 Hangers (Best Brand)
2 Floor Guides	BP250N-71 Floor Guides (Best Brand)
2 Carpet Risers	BP150-74 Zinc Carpet Risers (Best Brand)
2 Pulls	BP250-63 Brushed Nickel Flush Pulls (Best Brand)
1 Angle Stop	BP250-75 Zinc Angle Stop (Best Brand)

HW-9 (Classroom Set) Double Interior Door (Wood)

2 Each Lockset	9K Series Commercial Grade Door Lock Mortise Lever #15D ADA Compliant (Best Access Brand)

HW-10 (Classroom Set) Double Interior Door (Wood)

2 Panic Device	Precision 2200 – Rim Device (Exit/Panic Device with surface mounted vertical rods) with 4900A "A" Lever Trim (Precision APEX Brand)

HW-11 (Privacy Set) Single Interior Door (Wood)

3 Hinges	PBB 4B81 Commercial Grade Heavy Duty Weight Ball Bearing Hinge (PBB Brand)
1 Each Locksets	9K Series Commercial Grade Door Lock Mortise Lever #15D ADA Compliant (Best Access Brand)
1 Each Closer	Stanley D4550 Series Heavy Duty Door Closer with cover (Stanley Brand)
3 Door Silencers	DCI 307D Metal Frame Door Silencers (DCI Brand)
1 Each Wall/Hinge Stops	(Wall) DCI Concave Wall Mounted Door Stop/(Hinge) DCI Pin Door Stop (DCI Brand)
1 Kickplate	DCI Door Protection Plates 10" Height (DCI Brand)
1 Threshold	Marble Threshold

HW-12 (Detention Set) Single Interior Door (Hollow Metal)

Key Fob reader unlocks lockset. Outside lever always locked with power applied to solenoid. Unlocks by key fob reader or remote control, loss of power*, or fire alarm activation. Key fob reader, electric strike, power sully and remote control as per electrical specifications.

3 Hinges	IHTCB1901R Heavy Weight Concealed Bearing Prison Hinges (Best Brand)
1 Deadlatch	10120AM-2 Motor Operated Electro-Mechanical Deadlatch (Southern Steel Brand)
1 Each Closer	240CPS Concealed Position Switch (Southern Steel Brand)
2 Pulls	212C Raised Door Pulls (Southern Steel Brand)
1 Each Wall Stop	(Wall) DCI Concave Wall Mounted Door Stop

HW-13 (Detention Set) Single Interior Door (Hollow Metal)

1 Deadlatch	10120AM-2 Motor Operated Electro-Mechanical Deadlatch (Southern Steel Brand)

HW-14 (Classroom Set) Single Interior Door (Wood)

1 Panic Device	Precision 2100 – Rim Device (Exit/Panic Device) with 4900A “A” Lever Trim (Precision APEX Brand)

HW-15 (Privacy Set) Single Interior Door (Wood)

1 Each Locksets	9K Series Commercial Grade Door Lock Mortise Lever #15D ADA Compliant (Best Access Brand)

HW-16 (Detention Set) Single Interior Door (Hollow Metal)

1 Deadlatch	10120AM-1 Motor Operated Electro-Mechanical Deadlatch (Southern Steel Brand)

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Glazing, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. C669 - Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
      b. C920 - Elastomeric Joint Sealants
      c. C1036 - Flat Glass
      d. C1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
      e. D673 - Mar Resistance of Plastics
      f. D1547 - Extruded Acrylic Plastic Sheet
      g. E774 - Sealed Insulating Glass Units
   2. Code of Federal Regulations (CFR) Publication:
      a. 16-1201 - Safety Standard for Architectural Glazing Materials
   3. Federal Specification (FS):
      a. L-P-391 - Plastic Sheets, Rods and Tubing, Rigid Cast, Methacrylate (Multiapplication)
   4. Flat Glass Marketing Association (FGMA) Publications:
      a. GM - Glazing Manual
      b. SM - Sealant Manual
   5. Military Specifications (MIL):
      a. R-900 - Rubber Gasket Material, 45 Durometer Hardness
      b. P-46144 - Plastic Sheet, Polycarbonate
   6. National Fire Protection Association (NFPA) Publication:
      a. 80 - Fire Doors and Windows
   7. Sealed Insulating Glass Manufacturers Association (SIGMA) Publications:
      a. A1202 - Voluntary Guidelines for Commercial Insulating Glass Dimensional Tolerances
      b. A2801 - Voluntary Guidelines for Sloped Glazing of Organically Sealed Insulating Glass Units

c. A3000 - Recommended Practices for Vertical Field Glazing of Organically Sealed Insulating Glass Units
d. 73-8-2B - Test Method for Chemical Effects of Glazing Compounds on Elastomeric Edge Seals

8. Underwriters Laboratories, Inc. (UL) Publications:
a. ABMPED - Automotive Burglary Protection Mechanical Equipment Directory
b. 752 - Bullet-Resisting Equipment

1.03 SUBMITTALS

A. Submit the following.
1. Manufacturer's Instructions:
a. Setting and sealing materials
b. Glazing material installation
1) Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified. Include cleaning instructions for plastic sheets.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, dry locations, and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Engineer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.06 WARRANTY

A. Warranty for Insulating Glass Units: Warranty insulating glass units against development of material obstruction to vision (such as dust or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 5-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Owner.

B. Warranty for Polycarbonate Sheet: For a 5-year period following acceptance of the work:
   1. Warranty Type I, Class A (UV stabilized) sheets against breakage;
   2. Warranty Type III (coated, mar-resistant) sheets against breakage and against coating delamination;
   3. Warranty Type IV (coated sheet) against breakage and against yellowing;
   4. Warranty extruded polycarbonate profile sheet against breakage.
      a. For a 10-year period following acceptance of the work, warranty Type IV against yellowing and loss of light transmission.

PART 2 - PRODUCTS

2.01 GLASS

A. ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

B. Clear Glass: Type I, Class 1 (clear). Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8-inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not over 45 square feet.

C. Fire Rated Glazing: Clear (polished both sides), 1/4 inch thick, weight 3.0 lbs./sq. ft. specialty tempered fire rated glazing, impact safety resistant meeting CPSC 16 CFR 1201 Cat. I (150 ft. lbs.; limited to 1,296 sq. in.) & II (400 ft. lbs.; up to maximum size tested, sound transmission rating must be 0.88 flor clear tempered. In addition, glass for fire doors shall conform to NFPA 80.

2.02 INSULATING GLASS UNITS

A. Two panes of glass separated by a dehydrated airspace and hermetically sealed. Dimensional tolerances shall be as specified in SIGMA A1202. The units shall conform to ASTM E774, Class A. Unit seals shall be compatible with glazing sealants when tested in accordance with SIGMA 73-8-2B.

2.03 SETTING MATERIALS

A. Provide as specified in the FGMA GM, SIGMA A3000, SIGMA A2801, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, non-skinning compounds, non-resilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

B. Elastomeric Sealant: ASTM C920, Type S or M, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units. Color of sealant shall be as selected from manufacturer's full range of color options.

C. Preformed Channels: Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition. Channels for bullet-resistant glass shall be synthetic rubber, MIL-R-900, not less than 1/4 inch thick and sufficiently resilient to accommodate expansion and contraction while maintaining a vapor tight seal between glass and frame. Channels shall be chemically compatible with plastic sheet.

D. Sealing Tapes: Preformed, semi-solid, polymeric-based material of proper size and compressibility for the particular condition. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

E. Setting Blocks and Edge Blocks: Lead or neoprene of 70 to 90 Shore "A" durometer hardness, chemically compatible with sealants used, and of sizes recommended by the glass manufacturer.

F. Accessories: Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

PART 3 - EXECUTION

3.01 PREPARATION

A. Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the FGMA GM, FGMA SM, SIGMA A2801, SIGMA A3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.02 GLASS SETTING

A. Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the FGMA GM, FGMA SM, SIGMA A2801, SIGMA A3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place.

B. Sheet Glass: Cut and set with the visible lines or waves horizontal.

C. Insulating Glass Units: Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of SIGMA A2801 and SIGMA A3000.

D. Installation of Fire Rated Glazing: Install glass for fire doors in accordance with installation requirements of NFPA 80.

E. Plastic Sheet: Conform to manufacturer's recommendations for edge clearance, type of sealant and tape, and method of installation.

3.03 CLEANING

A. Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Gypsum Board Assemblies, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. C36 - Gypsum Wallboard
      b. C442 - Gypsum Backing Board and Coreboard
      c. C475 - Joint Treatment Materials for Gypsum Wallboard Construction
      d. C514 - Nails for the Application of Gypsum Wallboard
      e. C557 - Adhesives for Fastening Gypsum Wallboard to Wood Framing
      f. C1396/1396M - Water-Resistant Gypsum Backing Board
      g. C840 - Application and Finishing Gypsum Board
      h. C931 - Exterior Gypsum Soffit Board
      i. C960 - Predecorated Gypsum Board
      j. C1002 - Steel Drill Screws for the Application of Gypsum Board
      k. E84 - Surface Burning Characteristics of Building Materials
   2. Gypsum Association (GA) Publications:
      a. 224 - Installation of Predecorated Gypsum Board
      b. 600 - Fire Resistance Design Manual
   3. Underwriters Laboratories, Inc. (UL) Publication:
      a. FRD - Fire Resistance Directory

1.03 SUBMITTALS

A. Submit the following.
   1. Manufacturer's Catalog Data:
      a. Gypsum board
      b. Fasteners
      c. Joint treatment materials
      d. Adhesives

e. Metal trim

2. Color Selection Samples:

a. Predecorated gypsum board

1) Submit sample of each color and pattern of predecorated gypsum board. Where colors are not indicated, submit samples of not less than eight of the manufacturer's standard colors for selection by the Engineer.

1.04 DELIVERY, HANDLING, AND STORAGE

A. Delivery: Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

B. Handling: Neatly stack gypsum board flat to prevent sagging or damage to the edges, ends, and surfaces.

C. Storage: Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

1.05 ENVIRONMENTAL CONDITIONS

A. Temperature: Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board and joint treatment materials, or the bonding of adhesives.

B. Exposure to Weather: Protect gypsum board products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Shall conform to the respective specifications and standards and to the requirements specified herein. Provide gypsum board manufactured from asbestos-free materials.

B. Gypsum Wallboard: ASTM C36.

1. Regular: 48 inches wide, 5/8-inch thick, tapered and featured edges.
2. Type X (Special Fire-Resistant): 48 inches wide, 5/8-inch thick, tapered and featured edges.

C. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M.
   1. Regular: 48 inches wide, 5/8-inch thick, tapered edges.
   2. Type X (Special Fire-Resistant): 48 inches wide, 5/8-inch thick, square or tapered edges.

D. Joint Treatment Materials: ASTM C475.
   1. Embedding Compound: Specifically formulated and manufactured for use in embedding tape at gypsum board joints and completely compatible with tape, substrate and fasteners.
   2. Finishing or Topping Compound: Specifically formulated and manufactured for use as a finishing compound.
   3. All-Purpose Compound: Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.
   4. Joint Tape: Cross-laminated, tapered edge, reinforced paper, or special tape recommended by the manufacturer.

E. Screws: ASTM C1002. Type "G," Type "S" or Type "W" steel drill screws. Use specially designed steel screws as recommended by the manufacturer of the gypsum board for the screw application of gypsum board to gypsum board or to steel or wood framing.

F. Adhesives: Adhesive containing benzene, carbon tetrachloride, or trichloroethylene shall not be used.
   1. Adhesive for Fastening Gypsum Board to Metal Framing: Type as recommended by the gypsum board manufacturer.
   2. Adhesive for Fastening Gypsum Board to Wood Framing: ASTM C557.
   3. Adhesive for Laminating: Adhesive for Laminating Two-Ply Gypsum Board Systems and Gypsum Studs to Face Panels: Type as recommended by the gypsum board manufacturer.

G. Corner Bead and Edge Trim: Fabricate from corrosive protective coated steel or plastic designed for its intended use. Flanges shall be free of dirt, grease, and other materials that may adversely affect the bond of joint treatment. Materials shall be prefinished or job decorated.

H. Water: Clean, fresh, and potable.

PART 3 - EXECUTION

3.01 INSPECTION

A. Framing and Furring: Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board.

B. Gypsum Board and Framing: Verify that surfaces of gypsum board and framing to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

C. Masonry and Concrete Walls: Verify that surfaces of masonry and concrete walls to receive gypsum board applied with adhesive are dry, free of dust, oil, form release agents, protrusions and voids, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.02 APPLICATION OF GYPSUM BOARD

A. Apply gypsum board to framing and furring members in accordance with ASTM C840 and the requirements specified herein. Apply gypsum board with separate boards in moderate contact; do not force in place. Stagger end joints of adjoining boards. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. In vertical application of gypsum board, panels shall be of length required to reach full height of vertical surfaces in one continuous piece. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Leave a space approximately 1/4 inch at bottom of gypsum board for calking.

B. Application of Gypsum Board To Masonry and Concrete Walls: Apply in accordance with ASTM C840, System VI.

C. Application of Gypsum Board to Steel Framing and Furring: Apply in accordance with ASTM C840, System VIII.

D. Application of Gypsum Board as a Substrate to Receive Ceramic Tile: In dry areas, apply water resistant gypsum board in accordance with ASTM C840, System X. In wet areas (tubs, shower enclosures, saunas, steam rooms, gang shower rooms), substrate to receive ceramic tile in specified Section 09 30 19.01, "Ceramic Tile, Quarry Tile and Pave Tile".

E. Exterior Application: Apply gypsum soffit board in accordance with ASTM C840, System XI.

F. Floating Interior Angles for Ceilings and Walls: Locate the attachment of fasteners adjacent to ceiling and wall intersections in accordance with ASTM C840, System XII, for single-ply and two-ply applications of gypsum board to wood framing.

G. Control Joints: Install expansion and contraction joints in ceilings and walls in accordance with ASTM C840, System XIII, unless indicated otherwise.

H. Application of Foil-Backed Gypsum Board: Apply foil-backed gypsum board in accordance with ASTM C840, System XIV.

3.03 FINISHING OF GYPSUM BOARD

A. Tape and finish gypsum board in accordance with ASTM C840. Provide joint, fastener depression, and corner treatment. Treatment for water-resistant gypsum board shall be as recommended by the gypsum board manufacturer.

3.04 CAULKING

A. Calk openings around pipes, fixtures, and other items projecting through gypsum board as specified in Section 07 92 00, "Joint Sealants". Apply caulking material with exposed surface flush with gypsum board.

3.05 FIRE-RESISTANT ASSEMBLIES

A. Wherever fire-rated gypsum board construction is indicated, provide all materials and application methods, including types and spacing of fasteners, in accordance with the specifications contained in the UL FRD for the Design Number(s) indicated, or the GA 600 for the File Number(s) indicated.

3.06 PATCHING

A. Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Non-structural Metal Framing, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications:
      a. A463 - Steel Sheet, Cold-Rolled, Aluminum-Coated Type 1
      b. A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
      c. C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board, or Water-Resistant Backing Board
   2. Underwriters Laboratories, Inc. (UL) Publication:
      a. Fire Resistance Directory

1.03 DESCRIPTION OF WORK

A. Work includes nonload-bearing cold-formed metal framing, furring, and ceiling suspension systems for the attachment of wallboard. Load-bearing cold-formed steel framing is specified in Section 05 40 00, "Cold-Formed Metal Framing". Metal suspension systems for acoustical ceilings are specified in Section 09 51 23, "Acoustical Tile Ceilings".

1.04 SUBMITTALS

A. Certificates of Compliance: Manufacturer's certificates attesting that materials meet the requirements specified herein and in referenced publications.

B. Shop Drawings: Necessary for the erection of metal framing and furring. Indicate materials, sizes, thicknesses, and fastenings.

C. Manufacturer's Erection Instructions: Printed instructions for the erection of metal framing and furring.

1.05 DELIVERY AND STORAGE

A. Deliver materials to the job site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If it is necessary to store materials outdoors, stack materials off the ground, properly supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items that cannot be restored to like-new condition and provide new items.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide steel materials for metal support systems with galvanized coating ASTM A525, G-60; aluminum coating ASTM A463, T1-25; or a 55 percent aluminum-zinc coating.

B. Materials for Use in Suspended and Furred Ceiling Systems for Attachment of Gypsum Wallboard: ASTM C754.

C. Materials for Use in Nonload-Bearing Wall Framing and Furring for Attachment of Gypsum Wallboard: ASTM C754.

D. Materials for Use in Furring Structural Steel Columns for Attachment of Gypsum Wallboard: ASTM C754. Steel (furring) clips and support angles listed in UL's "Fire Resistance Directory" may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

E. Z-Furring Channels for Attachment of Gypsum Wallboard Over Wall Insulation: Not less than 26-gage galvanized steel, Z-shaped, with 1-1/4-inch and 3/4-inch flanges and furring depth as required by the insulation thickness provided.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Suspended and Furred Ceiling Systems for Attachment of Gypsum Wallboard: ASTM C754, except as indicated otherwise.

B. Nonload-Bearing Wall Framing and Furring for Attachment of Gypsum Wallboard: ASTM C754, except as indicated otherwise.

C. Furring Structural Steel Columns for Attachment of Gypsum Wallboard: Install studs or galvanized steel clips and support angles for erection of gypsum wallboard around structural steel columns in accordance with the UL Fire Resistance Directory, Design Number(s) of the fire resistance rating indicated.

D. Z-Furring Channels for Attachment of Gypsum Wallboard Over Wall Insulation: Install Z-furring channels vertically spaced not more than 24 inches on centers. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry and concrete walls with powder-driven fasteners or hardened concrete steel nails through narrow flange of channel. Space fasteners not more than 24 inches on centers.

END OF SECTION

SECTION 09 30 19.01

CERAMIC TILE, QUARRY TILE, AND PAVER TILE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Ceramic Tile, Quarry Tile, and Paver Tile, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. American National Standards Institute (ANSI) Publications:
   a. A108.1 Glazed Wall Tile Ceramic Mosaic Tile, Quarry Tile and Paver Tile Installed with Portland Cement Mortar
   b. A108.4 Ceramic Tile Installed with Organic Adhesive or Water Cleanable and Tile Setting Epoxy
   c. A108.5 Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
   d. A108.6 Ceramic Tile Installed with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy
   e. A118.1 Dry-Set Portland Cement Mortar
   f. A118.3 Chemical Resistant, Water Cleanable Tile - Setting and Grouting Epoxy and Epoxy Adhesives
   g. A118.4 Latex-Portland Cement Mortar
   h. A136.1 Organic Adhesives for Installation of Ceramic Tile
   i. A137.1 Ceramic Tile
2. American Society for Testing and Materials (ASTM) Publications:
   a. A185 Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
   b. A497 Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
   c. C150 Portland Cement
   d. C395 Chemical-Resistant Resin Mortars
   e. C658 Chemical-Resistant Resin Grouts for Brick or Tile
   f. C811 Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacings
   g. F446 Grab Bars and Accessories Installed in Bathing Area

1.03 SUBMITTALS

A. Samples: Submit the following:
   1. Porcelain Floor Tile: 12 x 24 inch square sheets mounted showing colors, finish, pattern, and form of each type, with joints between the tiles grouted.
   2. Wall Tile: Sets of four tiles showing size, form, finish, and range and shades in each color, with joints between the tiles grouted.

B. Certificates of Compliance: Submit a Master Grade Certificate for tile, certifying the grade, type, and quantity of material. Certified tile shall bear certification marks on cartons or labels. Submit certificates using the form cited in ANSI A137.1. In lieu of Master Grade Certificate and certification marks, a manufacturer's certificate of compliance may be submitted. The manufacturers' certificates must show that the tile meets the requirements of ANSI A137.1.

1.04 DELIVERY, STORAGE, AND HANDLING

A. ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-1.

1.05 ENVIRONMENTAL CONDITIONS

A. ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6 Section A-1 as modified herein. Do not start tile work unless the ambient temperature in work area is at least 50 degrees F and rising. Maintain the ambient temperature above 50 degrees F while work is in progress and for at least 3 days after its completion. For the installation and subsequent cure of chemical-resistant epoxy and furan mortars, the temperature shall be at least 60 degrees F and rising for a period of time recommended by the manufacturer. Do not use adhesives in unventilated areas.

1.06 EXTRA STOCK

A. Supply an extra two percent of each type tile used in clean and marked cartons.

PART 2 - PRODUCTS

2.01 MATERIALS: ANSI A108.1, ANSI A108.4, ANSI A108.5, AND ANSI A108.6 SECTION A-2.

A. Tile: ANSI A137.1, Standard Grade.

1. Color and Patterns: Tile colors and patterns shall be as indicated. Colors and patterns indicated by reference to manufacturer's name and designations are for color and pattern identification only and are not intended to limit selection of other manufacturer's products with similar colors and patterns.

2. Floor Tile:

a. Unglazed Tile: ANSI A137.1, porcelain or natural clay with cushioned edges.

Nominal Facial Dimensions in inches:	Nominal Thickness in inches:
As indicated on Drawings	1/4

Slip resistant: The body of the tile shall have a content of 7.5 plus or minus percent by weight of abrasive grains.

3. Wall Tile:

a. Glazed Wall Tile: ANSI A137.1, matte finish with cushioned edges.

Nominal Facial Dimensions in inches:	Nominal Thickness in inches:
As indicated on Drawings	1/4 or 5/16

4. Trim Units: Provide matching trim units and accessories with tile work. Provide where indicated for a complete and finished installation. Identification numbers for trim unit shapes are cited in ANSI A137.1. Provide bullnose units for wainscots, except here wainscot is flush with abutting wall surface. Provide up-and-down corners with bullnose units where there is a break in wainscot height, or where the wainscot does not terminate against projecting construction. Provide coved base units for wainscots, and 4-inch coved base units for tile floors where wainscots are not provided. Internal corners shall be squared and external corners rounded using appropriate matching trim units.

B. Hydrated Lime: ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-2.

C. Aggregate: ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-2.

D. Water: Clean, potable.

E. Portland Cement: ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-2.

F. Membrane or Cleavage Membrane: ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-2.

G. Metal Dividing Strips: Heavy-top terrazzo type, brass or zinc alloy, approximately 1/16 inch thick with 1/4-inch thick top, and depth equal to thickness of tile plus setting bed.

H. Thresholds: Hard, sound, domestic marble, approximately 1-1/4 inches thick, with rounded edges and sand-rubbed finish on exposed surfaces. Bevel where shown on drawings.

I. Window Stools: Hard, sound, domestic marble, not less than 7/8 inch thick, with polished finish on exposed surfaces. Color shall be as selected by Owner. Exposed edges and corners shall be slightly rounded.

J. Mortars and Grouts:
   1. Mortar, Adhesives, and Tile Setting:
      a. Portland Cement Mortar: ANSI A108.1 Section A4.1 for proportions, color to be selected by Owner.
      b. Dry-Set Portland Cement Mortar: ANSI A118.1, factory sanded.
      c. Latex-Portland Cement Mortar: ANSI A118.4.
      d. Chemical-Resistant, Water-Cleanable, Tile-Setting and Grouting Epoxy: ANSI A118.3.
      e. Furan: ASTM C395.
      f. Organic Adhesive: ANSI A136.1.
   2. Grout:
      a. Commercial Portland Cement: ASTM C150; ANSI A108.1, Section A4.1 for proportions.
      b. Sand Portland Cement: ASTM C150; ANSI A108.1, Section A4.1 for proportions.
      c. Dry Set: ANSI A118.1, factory sanded.
      d. Latex-Portland Cement: ANSI A118.4.
      e. Chemical-Resistant, Water-Cleanable, Tile-Setting and Grouting Epoxy: ANSI A118.3.
      f. Furan: ASTM C658.

K. Sealants and Caulkings: Provide sealants and caulkings in joints between tile and furnishings. Color of sealants as selected by Owner.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not start tile work until roughing in for plumbing, heating, ventilating, air conditioning, and electrical work has been installed and tested; and built-in bathtubs, shower stalls, and membrane waterproofing have been installed and tested.

3.02 PREPARATION

A. Concrete Subfloor Preparation: Do not begin floor tile installation in areas receiving wall tile until wall tile installation has been completed.
   1. Precast and Structural Slabs Subject to Bending: Prepare in accordance with ANSI A108.1
   2. Structural Slabs With Limited Bending: Prepare in accordance with ANSI A108.1. Before applying tile with dry set mortar, test structural concrete floor for levelness or uniformity of slope by using straightedges. Fill areas where the floor does not meet the required tolerances and level in accordance ANSI A108.5 and Section 03 30 00, "Cast-in-Place Concrete". Provide expansion joints where indicated.

B. Preparation of Mortar Mixes: Measure mortar materials in approved containers to ensure that proportions of materials will be controlled and accurately maintained. Measuring materials with shovels is not permitted. Unless specified otherwise, mix mortar in proportions by volume in approved mixing machines or mortar boxes. Control the quantity of water accurately and uniformly.

3.03 INSTALLATION

A. Floor Tile
   1. Portland Cement Mortar: ANSI A108.1 Recess, or depress setting bed where indicated.
   2. Chemical-Resistant, Water-Cleanable, Tile-Setting and Grouting Epoxy: ANSI A108.6.
   3. Dry-Set Mortar: ANSI A108.5.
   4. Latex-Portland Cement Mortar: ANSI A108.5.
   5. Furan: ASTM C811.

B. Wall Tile:
   1. Portland Cement Mortar: ANSI A108.1 Dry-Set Mortar: ANSI A108.5.
   2. Latex-Portland Cement Mortar: ANSI A108.5.
   3. Water-Resistant, Organic Adhesive: ANSI A108.4.
   4. Chemical-Resistant, Water-Cleanable, Tile-Setting and Grouting Epoxy: ANSI A108.6. Clean in accordance with the manufacturer's recommendations.

C. Joints: Make parallel, plumb, level, and in alignment. Make end joints in broken-joint work on center lines of adjoining tiles, as far as practicable. Set square tiles with straight joints, and set oblong tiles with broken joints, except in special arrangements and design, where indicated.
   1. Joint Width: Make joints uniform in width and space to accommodate tile with a minimum of cutting, but maintain standard mounting widths between units abutting sheets of mounted ceramic mosaic tile. Make joint widths as follows:
      a. Mounted Tile: As determined by the mounted tile spacing.
      b. Unmounted Glazed Wall Tile: As determined by spacing lugs.
      c. Quarry Tile: 1/4 inch minimum, width of 3/8 inch maximum.
      d. Trim Units and Accessories: Match adjoining tile units.
   2. Grouting and Pointing Joints: Factory premixed colored grout. Color shall be selected by Owner.
      a. Grout glazed wall tile in accordance with ANSI A108.1.

   3. Expansion and Control Joints: Provide expansion and control joints in tile work in accordance with ANSI A108.1, ANSI A108.4, ANSI A108.5 and ANSI A108.6 and where indicated. Install expansion and control joints as follows:
      a. Insert preformed joint filler or back-up material in joints to proper depth to provide correct cavity depth for sealant.
      b. Prior to grouting, keep joints open and clean by stuffing with paper or other material to prevent filling with dirt, grout, or mortar.
      c. After tile is grouted and completely dry, remove paper or other temporary filler material; brush joints clean and fill with back-up material and sealant.

D. Metal Dividing Strips: Install dividing strips in mortar setting bed while bed is in a plastic state. Set dividing strips where indicated in straight, unbroken lines, flush with unfinished floor surface. Provide dividing strips at joints where floor tile abuts and is flush with other types of floor finishes, except at doors where thresholds are provided.

E. Thresholds: Align edges with faces of trim on both sides of openings. Fit thresholds neatly and bed properly in cement mortar flush with adjoining floors.

F. Curing: Delete inapplicable references. Cover floors with 30-pound natural kraft paper with joints overlapping at least 4 inches and tape-sealed or held down with planks or other weights. Allow to damp cure for at least 72 hours before permitting foot traffic on tiled floor. Cure in accordance with ANSI A108.1.

3.04 CLEANING

A. Clean in accordance with ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6, Section A-3. Acid cleaning of unglazed tile, when necessary, shall be done no sooner than 14 days after setting tile.

3.05 PROTECTION

A. Meet the requirements of ANSI A108.1, ANSI A108.4, ANSI A108.5, and ANSI A108.6 Section A-3. Cover finished tile floors with clean, 30-pound natural kraft paper before permitting foot traffic. Place board walkways on floors that are to be continuously used as passageways by workers. Cover marble stools and thresholds with boards. Protect tiled corners, external angles, with board corner strips in areas used as passageways by workers.

END OF SECTION

SECTION 09 51 23

ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Acoustical Tile Ceilings, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM) Publications:
1. A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, Strip, Specification
2. A366 - Steel Sheet, Carbon, Cold-Rolled, Commercial Quality
3. A526 - Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process, Commercial Quality
4. A580 - Stainless and Heat-Resisting Steel Wire
5. B633 - Electrodeposited Coatings of Zinc on Iron and Steel
6. C423 - Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
7. C635 - Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
8. C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
9. C834 - Latex Sealing Compounds
10. D217 - Cone Penetration of Lubricating Grease
11. D1779 - Adhesive for Acoustical Materials
12. E84 - Surface Burning Characteristics of Building Materials
13. E119 - Fire Tests of Building Construction and Materials
14. E413 - Determination of Sound Transmission Class
15. E795 - Mounting Test Specimens During Sound Absorption Tests
16. Ceiling and Interior Systems Contractors Association (CISCA) Publication:
    a. AMA1-II - Ceiling Sound Transmission Test by Two-Room Method

17. Federal Specifications (FS):
    a. SS-S-118 - Sound Controlling (Acoustical) Tiles and Panels
    b. QQ-N-281 - Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections
    c. QQ-W-461 - Wire, Steel, Carbon (Round, Bare and Coated)
18. Underwriters Laboratory, Inc. (UL) Publication:
    a. FRD - Fire Resistance Directory

1.03 SUBMITTALS

A. Submit the following.
    1. Manufacturer's Catalog Data:
        a. Acoustical units
        b. Suspension systems

1.04 DESIGN CRITERIA FOR CEILING SYSTEM

A. Fire Endurance: The fire endurance (separation) rating of the acoustical tile ceiling (ATC) system(s), including ceiling penetrations such as light fixtures and electric boxes, shall be as indicated when determined by ASTM E119. Flame spread of acoustical units shall be 25 or less, and smoke development shall be 50 or less when tested in accordance with ASTM E84.

B. Ceiling Sound Transmission Class: The ceiling sound transmission class (ceiling STC range) of the ceiling system shall be 35-39 for ATC-1 and 55 for ATC-2 when determined in accordance with CISCA AMA1-II and reported in accordance with ASTM E413 for 16 frequency data. Test ceiling shall be continuous at the partition and shall be assembled in the suspension system in the same manner that the ceiling will be installed on the project.

C. Ceiling Sound Absorption: Determine the NRC in accordance with ASTM C423 Method of Test.

1.05 DELIVERY AND STORAGE

A. Deliver acoustical units in the manufacturer's original unopened containers with brand name and type clearly marked. Handle materials carefully, and store them under cover in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed.

1.06 ENVIRONMENTAL CONDITIONS

A. For 24 hours before, during, and 24 hours after installation of acoustical units, maintain temperature and relative humidity at typical in-service conditions. Interior finish work such as plastering, concrete, and terrazzo work shall be

completed and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and approved prior to the start of acoustical ceiling installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Acoustical Tile Ceiling (ATC) Units: FS SS-S-118, and the following requirements.

1. Composition Lay-In Panels; ATC-1:
   a. Type: Type III (Non-asbestos mineral composition with factory-applied standard washable painted finish. Color white.
   b. Form: 1, 2, or 3.
   c. Class: A, flame spread 25 or less.
   d. Pattern: CE, fine, small holes, perforated.
   e. Noise Reduction Coefficient (NRC) Grade: Minimum 0.35 when tested on Mounting Type E-400 of ASTM E795.
   f. Light Reflectance (LR) Coefficient: LR-1, 0.81 or greater.
   g. Nominal Size: 24 by 24 inches.
   h. Edge Detail: Square.
2. Composition Tile; ATC-2:
   a. Type: Type III (Non-asbestos mineral composition with factory-applied standard washable painted finish. Color white.
   b. Form: 1, 2, or 3.
   c. Class: A, flame spread 25 or less.
   d. Pattern: CE, fine, small holes, perforated.
   e. Noise Reduction Coefficient (NRC) Grade: Minimum 0.55 when tested on Mounting Type E-400 of ASTM E795.
   f. Light Reflectance (LR) Coefficient: LR-1, 0.81 or greater.
   g. Nominal Size: 24 by 24 inches.
   h. Edge Detail: Square.

3. Unit Acoustical Absorbers: Individually mounted sound absorbing plaques composed of glass fibers or non-asbestos mineral fibers and having a NRC range of not less than 0.60 - 0.70 when tested in accordance with ASTM C423 and reported as a 4 frequency average.

2.02 SUSPENSION SYSTEM

A. ASTM C635 and the following requirements:

1. Type: Exposed grid for ATC-1 and for ATC-2.
2. Structural Classification: Intermediate duty for ATC-1 and Intermediate duty for ATC-2 for main runners and cross tees.

3. Finish: Surfaces exposed to view shall be of uniform width and shall be aluminum or steel with factory applied white baked enamel finish. Zinc coated steel shall receive a phosphate treatment prior to painting
4. Accessories: Provide manufacturer's standard hold down clips and wall or edge moldings.

B. Hangers:
1. Wires: FS QQ-W-461, composition 1010, soft annealed, light zinc-coated finish, 0.1055 inches in diameter (12 gauge).

2.03 ACOUSTICAL SEALANT

A. Synthetic rubber or polymeric-based material complying with ASTM C834 and having the following properties:
1. Consistency: 290 to 310 per ASTM D217.
2. Aging: Slightly tacky at 160 degrees F after 50 days.
3. Accelerated aging: No significant change after 260 hours in weatherometer.
4. Nonstaining.
5. Solids content: Approximately 80 to 90 percent.
6. No oil migration.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Areas where acoustical units will be cemented shall be free of oils, form residue, or other materials that reduce bonding capabilities of the adhesive.

3.02 INSTALLATION

A. Suspended Ceilings: ASTM C636.
1. Hangers: Space hangers 4 feet on centers each direction. Lay hangers out for each individual room or space. Install additional hangers where required to support framing around beams, ducts, columns, grilles and other penetrations through the ceiling.
2. Suspension Members: Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span.
3. Acoustical Units: Edges of ceiling tiles shall be in close contact with metal supports with each other and in true alignment. Arrange units so that units less than 1/2 width are minimized.

4. Wall or Edge Molding: Install wall molding at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.
5. Hold Down Clips: Provide hold down clips for all panels in ceiling system and around troffer lights.
6. Calking: Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings. See Section 07 92 00, "Sealants".

3.03 CLEANING

A. Clean soiled or discolored unit surfaces after installation. Touch up scratches, abrasions, voids and other defects in painted surfaces. Remove damaged or improperly installed units and install new materials.

3.04 MAINTENANCE MATERIAL (EXTRA STOCK)

A. Furnish one spare acoustical unit for each 100 units installed.

END OF SECTION

SECTION 09 54 23

LINEAR METAL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Conditions of Contract, including General and Supplementary Conditions and Divisions 1 Specification sections apply to work of this Section.

1.02 SUMMARY

A. Section Includes:
   1. Metal ceiling panels.
   2. Exposed grid suspension system.
   3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

B. Related Sections:
   1. Section 09 20 00 - Plaster and Gypsum Board
   2. Divisions 23 - HVAC
   3. Division 26 Sections - Electrical Work

C. Alternates
   1. Prior Approval: Unless otherwise provided for in the Contract documents, proposed product substitutions may be submitted no later than ten (10) working days prior to the date established for receipt of bids. Acceptability of a proposed substitution is contingent upon the Architect's review of the proposal for acceptability and approved products will be set forth by the Addenda. If included in a Bid are substitute products which have not been approved by Addenda, the specified products shall be provided without additional compensation.
   2. Submittals which do not provide adequate data for the product evaluation will not be considered. The proposed substitution must meet all requirements of this section, including but not necessarily limited to, the following: Single source materials suppliers; Factory Mutual classified acoustical performance, panel design, size, composition, color, and finish; suspension system component profiles and sizes; compliance with the referenced standards.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process.
   3. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
   6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
   7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   8. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
   9. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems.
   10. ASTM E 1264 Classification for Acoustical Ceiling Products.
   11. ASTM E 1477 Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.

B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.

C. Samples: Minimum 4 inch x 4 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

D. Shop Drawings: Layout and details of ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.

E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC and AC.

F. If the material supplied by the acoustical subcontractor does not have a Factory Mutual classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the Architect's or Owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
   1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
      a. Flame Spread: 25 or less
      b. Smoke Developed: 50 or less

C. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store the ceiling panels in a dry, interior location and keep in cartons prior to installation to avoid damage.

B. Exercise care in moving and opening cartons to prevent damage to the panel face.

1.07 PROJECT CONDITIONS

A. Space Enclosure:
   1. All ceiling products and suspension systems must be installed and maintained in accordance with Armstrong written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions.
   2. Abnormal conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.
   3. Standard Ceilings: Do not install interior ceilings until space is enclosed and weatherproof; wet work in place is completed and nominally dry; work above ceilings is complete; and ambient conditions of temperature and humidity are continuously maintained at values near those intended or

final occupancy. Building areas to receive ceilings shall be free of construction dust and debris.

1.08 WARRANTY

A. Ceiling Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
   1. Ceiling Panels: Sagging and warping
   2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:
   1. Ceiling panels: One (1) years from date of substantial completion.
   2. Grid: Ten (10) years from date of substantial completion.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.09 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
   2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Ceiling Panels:
   1. Armstrong World Industries, Inc., or approved equal

B. Suspension Systems:
   1. Armstrong World Industries, Inc., or approved equal

2.02 METAL CEILINGS PANELS

A. Ceiling Panels Type “LINEAR METAL”:
   1. Surface Texture: Smooth
   2. Composition: Electrogalvanized Steel – 12 gauge galvanized steel with post production powder coated paint finish
   3. Color: As selected by Owner from Manufacturer’s full range of colors.

4. Size: 12 inch widths, up to 12 foot lengths
5. Perforation Options: (unperforated) (perforated)
6. Edge Profile: Screw In Concealed Locking (tested to withstand 960 – 3100 lbs of force)
7. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, (unperforated - N/A), (perforated with optional fiberglass infill item #8200100 – 0.80)
8. Flame Spread: ASTM E 1264; Class A (FM)
9. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: (unperforated - 0.77) (perforated – 0.61)
10. Dimensional Stability: Standard
11. Acceptable Product: MetalWorks SecureLock Plus, as manufactured by Armstrong World Industries, or approved equal.

B. Accessories:
1. Fiberglass infill; Item #820-01-00
2. Access Door Panel; Item #5949

2.03 SUSPENSION SYSTEMS

A. Edge Moldings: Metal or stainless steel of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated.

B. Accessories:
1. SecureLock Plus Hold Down Clips; Item #5595
2. C Channel; 14 gauge, Item #5397WH
3. Midspan Strut; Item #5593WH
4. Z Clips; 14 gauge, Item #5599

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.

3.02 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.03 INSTALLATION

A. Install suspension system and panels in compliance with ASTM C636, with the authorities having jurisdiction, and in accordance with the manufacturer's installation instructions:
   1. MetalWorks SecureLock Plus Installation Instructions, LA-297583
   2. MetalWorks Cutting Instructions, LA 295518

B. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

C. Follow the instructions found in "MetalWorks SecureLock Plus Installation Instructions", LA-297583 for border treatment of the MetalWorks SecureLock Plus panels. The face of the suspension system rests directly on the molding or trim flange.

D. Installation consideration: For a 12 or 16 gauge plank system, the perimeter connection must support a 3,000 lb upward load applied anywhere along the panel edge within 3 inches of the perimeter channel.

3.04 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Resilient base.
   2. Resilient stair accessories.
   3. Resilient molding accessories.

1.03 ACTION SUBMITTALS

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

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

D. Product Schedule: For resilient products. Use same designations indicated on drawings.

1.04 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.05 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Mockups: Provide resilient products with mockups specified in other Sections.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.07 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 resilient products 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).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.01 RESILIENT BASE VB

A. Resilient Base:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armstrong World Industries, Inc.
      b. Johnsonite.
      c. Roppe Corporation, USA.
      d. An approved equal

B. Resilient Base Standard: ASTM F 1861.
   1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TV (vinyl, thermoplastic).
   2. Manufacturing Method: Group I (solid, homogeneous)
   3. Style: Cove (base with toe)

C. Minimum Thickness: 0.125 inch (3.2 mm)

D. Height: 4 inches (102 mm)

E. Lengths: Cut lengths, 48 inches (1219 mm) long or coils in manufacturer's standard lengths.

F. Outside Corners: Job formed or preformed

G. Inside Corners: Job formed.

H. Finish: As selected by Engineer from manufacturer's full range of finish options

I. Colors and Patterns: As selected by Engineer from full range of industry colors.

2.02 RESILIENT STAIR ACCESSORIES

A. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.

B. Nosing Height: 1-1/2 inches (38 mm).

C. Thickness: 1/4 inch (6 mm) and tapered to back edge.

D. Size: Lengths and depths to fit each stair tread in one piece.

E. Risers: Smooth, flat, coved-toe, 7 inches (178 mm) high by length matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
   1. Thickness: 0.125 inch (3.2 mm).

F. Colors and Patterns: As selected by Engineer from full range of industry colors.

2.03 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
      b. Johnsonite.
      c. Roppe Corporation, USA.
      d. An Approved Equal

B. Description: Cap for cove carpet, carpet bar for tackless installations, carpet edge for glue-down applications, nosing for carpet, joiner for tile and carpet or transition strips.

C. Material: Vinyl or rubber.

D. Profile and Dimensions: As indicated.

E. Colors and Patterns: As selected by Engineer from full range of industry colors.

2.04 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
   1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
   2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

E. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F710.
   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.
   4. Moisture Testing: Perform tests recommended by manufacturer and as follows.
   5. Proceed with installation only after substrates pass testing.
      a. Perform anhydrous calcium chloride test, ASTM F1869. 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 F2170. Proceed with installation only after substrates have maximum 75 percent 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. Do not install resilient products until they are same temperature as the space where they are to be installed.
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible.

3.04 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:
   1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
   2. Tightly adhere to substrates throughout length of each piece.
   3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet or resilient floor covering that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION

SECTION 09 65 19

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Resilient Tile Flooring, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publication:
      a. F1066 - Vinyl Composition Floor Tile
   2. Federal Specifications (FS):
      a. MMM-A-110 - Adhesive, Asphalt, Cut-Back Type (for Asphalt and Vinyl Asbestos Tiles)
      b. MMM-A-115 - Adhesive, Asphalt, Water Emulsion Type (for Asphalt and Vinyl Asbestos Tile)
      c. MMM-A-137 - Adhesive, Resilient Flooring (Water Soluble)
      d. P-F-430 - Finish, Floor, Water-Emulsion (for Use on Light Colored Floors)
      e. P-W-155 - Wax, Floor, Water-Emulsion
      f. RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant
      g. SS-T-312 - Tile, Floor: Asphalt, Rubber, Vinyl, Vinyl-Asbestos
      h. SS-W-40 - Wall Base: Rubber, and Vinyl Plastic
   3. National Fire Protection Association (NFPA) Publication:
      a. 99 - Health Care Facilities
   4. Underwriters Laboratories, Inc. (UL) Publications:
      a. 779 - Electrically Conductive Floorings
      b. HLED - Hazardous Location Equipment Directory

1.03 SUBMITTALS

A. Submit the following.
   1. Manufacturer's Catalog Data:
      a. Vinyl-composition tile
      b. Vinyl tile
      c. Rubber tile
      d. Wall base
      e. Conductive flooring

f. Stair treads
g. Adhesives
h. Underlayment

2. Color Selection Samples: Submit no less than 6 different samples of the manufacturer's standard colors and patterns for selection.
   a. Floor tiles
   b. Wall base
   c. Edging strip
      1)
3. Operation and Maintenance Manuals:
   a. Resilient tile flooring
      1) Upon completion, but prior to acceptance of the work, submit current copies of the flooring manufacturer's printed recommendations for maintenance methods and products for each type of flooring material.

1.04 DELIVERY AND STORAGE

A. Deliver materials to the job in the manufacturer's original, unopened containers with brands, names, and production runs clearly marked thereon. Handle materials carefully, and store them in their original containers at no less than 65 degrees F for at least 48 hours prior to starting work.

1.05 ENVIRONMENTAL CONDITIONS

A. Maintain the temperature of spaces in which flooring work is to be performed at no less than 65 degrees F at the floor level for at least 48 hours prior to starting the work, during the time the work is performed, and for at least 48 hours after the work is completed. Maintain a minimum temperature of 55 degrees F, thereafter. Provide adequate ventilation to remove moisture and fumes from the area.

1.06 EXTRA STOCK

A. Upon completion of work, deliver additional flooring and base to the Owner for use in repairs and maintenance. Additional materials of each color shall be from the same production run as the materials installed. Furnish the tile and base in their original boxes, properly marked, in the following quantities and with the colors in the same proportions as the installed materials:
   1. Vinyl tile 5% of the amount installed
   2. Wall base 5% of the amount installed
   3. Premolded inside base corners 12 pieces
   4. Premolded outside base corners 12 pieces

PART 2 - PRODUCTS

2.01 MATERIALS

A. The materials shall conform to the respective specifications and standards and to the requirements specified herein.

B. Color and Pattern: The color and pattern of the tile shall be uniformly distributed throughout the thickness of the tile. Resilient flooring materials of the same type, pattern, and color shall be of the same production run and shall be so marked. Variations in shades and off-pattern matches between containers are not acceptable. Flooring in a continuous area or replacement of damaged flooring in a continuous area shall be from the same production run and shall have the same shade and pattern.

C. Vinyl Tile: FS SS-T-312, Type III, 18 inches by 18 inches and 18 inches by 36 inches by 1/8 inch thick (0.125 inches). Receive pattern layout approval prior to layout of vinyl tile flooring from Owner.

D. Wall Base: The wall base shall be traditional wall base; FS SS-W-40, Type I, rubber, or Type II, vinyl plastic; Class 1, vinyl chloride, or Class 2, vinyl acetate; Style A, straight, adjacent to carpet and B, cove, adjacent to resilient flooring. The base shall be 6 inches high, 0.125 inch thick, and colors shall be as selected by the Owner from the manufacturer's full range of color options. Use a flexible base to conform to irregularities in the walls, partitions, and floors. Provide premolded corners in matching size, shape, and color for all right-angle inside and outside corners. Provide 0.125 inch thick premolded corners in matching size, shape, and color for all right angle inside and outside corners with a 0.125-inch thick base.

E. Lining Felt: The lining felt shall be 15-pound asphalt felt, as recommended by the flooring manufacturer.

F. Underlayment: Latex type, as recommended by the flooring manufacturer. Wood and hardboard underlayment are specified in Section 06 10 01, "Rough Carpentry".

G. Adhesives:
   1. Adhesive for Lining Felt: FS MMM-A-137.
   2. Adhesive for Vinyl Tile and Rubber Tile: As recommended by the flooring manufacturer.
   3. Adhesive for Rubber and Vinyl Wall Base: As recommended by the wall base manufacturer.

H. Crack Filler:
   1. Crack Filler for Floors: As recommended by the floor covering manufacturer.
   2. Crack Filler for Walls: As recommended by the wall base manufacturer.

I. Finish:
   1. Wax: FS P-W-155.
   2. Polish: FS P-F-430.

J. Edging Strips: Brass, aluminum, or other light-colored nonferrous metal.

K. Accessories: Standard products of the flooring manufacturer.

PART 3 - EXECUTION

3.01 CONDITION OF THE SURFACES

A. Do not install flooring on surfaces that are unsuitable for proper installation. Surfaces that are to receive flooring shall be clean, dry, smooth, firm, sound and free of oil, paint, wax, dirt, or other damaging materials.

B. Preparation of Surfaces:
   1. Concrete Floor Surfaces: Grind ridges and other uneven surfaces smooth. Concrete curing compounds, other than the types that do not adversely affect adhesive, shall be removed entirely from the slabs. Cut out and fill all cracks 1/16 inch wide and wider with a crack filler specified for this application. Provide a latex underlayment to fill the remaining holes, cracks, and depressions and for smoothing, leveling, and feather-edging the concrete. Remove loose particles; vacuum chalky, dusty surfaces; and prime the cleaned surfaces, if recommended by the flooring manufacturer.
   2. Wood Floor Surfaces, Except Plywood: Fill knot holes, cracks wider than 1/16 inch, and holes larger than 3/16 inch in diameter with a crack filler specified for this application. Plane, scrape, or sand smooth ridges or uneven surfaces. Set nail heads flush to the floor. Provide lining felt over the wood floor surface, if recommended by the floor covering manufacturer. Carefully cut the felt around vertical surfaces, and butt the seams in the felt. Stagger the cross seams. Apply adhesive in accordance with the manufacturer's written recommendations. Roll the felt into the adhesive with a three-section roller weighing no less than 100 pounds to remove any air bubbles and ensure complete adhesion of the flooring.
   3. Plywood and Hardboard Underlayment Surfaces: Set nail heads flush to the floor. Sand all joints smooth with a power sander, while avoiding oversanding. Fill gouges, chipped areas, and open joints with a hard-

setting filler intended for this purpose. Joints shall be left slightly open to allow for expansion and contraction. Allow the filler to dry, and then sand the underlayment surface smooth.

C. Moisture Test for Concrete Floors: As recommended by the floor covering manufacturer.

3.02 APPLICATION

A. To avoid damaging the floor, install the flooring after other tradesmen in the same area have completed their work. Apply the flooring and the accessories in accordance with the manufacturer's installation procedure. The work shall be performed by workmen experienced in the application of such flooring. Detailed requirements are as follows:

1. Adhesives: Apply adhesives in accordance with the adhesive manufacturer's printed directions. Smoking or the use of open flames or other immediate sources of ignition is strictly prohibited in the area where solvent-containing adhesives are being used or spread. Post conspicuous signs reading "NO SMOKING OR OPEN FLAME" in the area of the spread adhesive.
2. Flooring: Apply tile flooring in the patterns indicated. Start in the center of the room or area, and work from the center towards the edges. Keep the tile lines and joints square, symmetrical, tight, and even; and keep each floor in a true, level plane, except where indicated as being sloped. Vary the width of edge tiles as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular-shaped rooms make it impossible.
3. Cutting: Cut flooring to fit around permanent fixtures, built-in furniture, and pipes, and outlets. Cut flooring edges, fit the flooring, and scribe the flooring to the walls and partitions after the field flooring has been applied.
4. Edge Strips: Provide edging strips where the flooring terminates at points higher than the contiguous finished flooring, except at doorways where thresholds are provided. Anchor metal strips to the concrete floor surfaces by countersunk screws into metal or fiber expansion sleeves.

B. Application of Vinyl/Rubber Tile: Lay the tile in the adhesive in the indicated pattern. Immediately after completing the installation, roll the floors with a three-section roller weighing not less than 100 pounds, then sandbag the high points and raised edges until the danger of loosening has passed.

C. Application of Rubber and Vinyl Wall Base: Apply wall base after the flooring has been completed and the wall surface to which the base is to be applied is dry. Where wall base is used in conjunction with vinyl wall covering, cut vinyl wall

covering off at a point 1/4 inch below the top of the base, and spread the adhesive to the back of the base, as specified herein. Form inside and outside corners with base materials, as specified herein.

1. Surface Preparation: Fill cracks and voids in the wall with a crack filler specified for this application. Bring irregular surfaces to a smooth finish with a smoothing compound.
2. Wall Base: Apply base adhesive to the back of the base with a notched trowel, leaving approximately 1/4-inch bare space along the top edge of the base. Immediately press the base firmly against the wall, and move the base gently into place, making sure that the toe is in contact with the floor surface and the wall. Roll the entire vertical surface of the base with a hand roller, and press the toe of the base with a straight piece of wood to ensure proper alignment.

3.03 CLEANING AND FINISHING

A. Cleaning: Upon completion of the installation, follow the flooring manufacturer's recommendations to remove surplus adhesive, and clean the flooring and adjacent surfaces. Ten days after installing the flooring, wash the flooring, with the flooring manufacturer's recommended cleaning solution; rinse the flooring thoroughly with cool, clean water, while avoiding flooding the floor; and finish the floor as specified in paragraph entitled, "Finishing".

B. Give the flooring three coats of a metal cross-linked acrylic-copolymer sealer finish. The application method and coverage rate of each coat shall be in strict accordance with manufacturer's printed instructions. Do not buff the finish.

3.04 PROTECTION

A. Protect flooring from all traffic for a period of 48 hours after installation to allow adhesive to properly set. From the time of laying the floor until its acceptance, protect the floor from damage. Remove and replace defects which develop, such as damaged, loose, broken, or curled tiles prior to the final inspection.

END OF SECTION

SECTION 09 68 00

CARPETING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Carpeting, as shown on the Plans, as specified, and/or directed including carpet sheet, for direct glue-down installation, carpet tile, carpet accessories and substrate preparation for carpet and accessories.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Association of Textile Chemists and Colorists (AATCC) Publications:
      a. 8 - Colorfastness to Crocking: AATCC Crockmeter Method
      b. 16E - Colorfastness to Light: Water-Cooled Xenon-arc Lamp, Continuous Light
      c. 20A - Fiber Analysis: Quantitative
      d. 134 - Electrostatic Propensity of Carpets
   2. American Society for Testing and Materials (ASTM) Publications:
      a. D418 - Pile Yarn Floor Covering Construction
      b. D1335 - Tuft Bind of Pile Floor Coverings
      c. D1423 - Twist in Yarns by the Direct-Counting Method
      d. D2257 - Extractable Matter in Yarns
      e. E648 - Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
   3. Code of Federal Regulations (CFR):
      a. 16-1630 - Standard for the Surface Flammability of Carpet and Rugs
   4. Federal Specification (FS):
      a. DDD-C-0095 - Carpets and Rugs, Wool, Nylon, Acrylic, Modacrylic, Polyester, Polypropylene

1.03 SUBMITTALS

A. Submit the following:
   1. Manufacturer's Instructions:
      a. Carpet

1) Submit the carpet manufacturer's printed installation instructions. Include procedures for installation covering preparation of the substrate, seaming techniques, and recommended adhesives and tapes where applicable.

2. Color Samples:
   a. Sheet Carpet: 12-inch-square sample.
      1) Carpet Seam: 6-inch sample.
   b. Carpet Tile: Full-size sample.
      1) Exposed Edge, Transition, and other Accessory Stripping: 12-inch-long samples.
      2) Vinyl moldings.
         a) Submit no less than 6 different samples of the manufacturer's standard colors for selection.
3. Operation and Maintenance Manuals:
   a. Carpet
      1) Submit copies of the carpet manufacturer's maintenance manual. Include recommended type of cleaning equipment and materials, spotting and cleaning methods, and cleaning cycles.

B. Shop drawings showing the following: columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet, existing flooring materials to be removed, existing flooring materials to remain, carpet type, color, and dye lot, seam locations, types, and methods, type of subfloor, type of installation, pattern type, repeat size, location, direction, and starting point, pile direction, type, color, and location of inserts and borders, type, color, and location of edge, transition, and other accessory strips, transition details to other flooring materials.

C. Product Schedule: Use same room and product designations indicated on drawings and in schedules.

D. Sample Warranties: For special warranties.

1.04 DELIVERY AND STORAGE

A. Deliver carpet to the site in manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, and related information. Attach register number to each roll or stencil on the bale. Store in a safe, dry, clean, and well ventilated area. Store rolls flat, not standing on end and do not stack anything on top of carpet rolls. Do not open containers until needed for installation unless verifying inspection is required. If carpet is to be prefabricated at a carpet workroom, keep receiving records.

1.05 SAFETY

A. Carpet adhesives may contain toxic volatile components. Follow ventilation, personal protection, and other safety precautions as recommended by the manufacturer of the adhesive.

1.06 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Carpet Warranty: Written warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

C. Warranty Period: Ten years from Substantial Completion.

1.07 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Carpet: Full-width rolls and tiles equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.01 PHYSICAL REQUIREMENTS

A. Provide carpet of tufted, woven, fusion-bonded, or knitted construction; first quality; and free of visual blemishes, streaks, poorly dyed areas, and other physical and manufacturing defects. Use nontoxic carpet materials and treatments, reasonably nonallergenic, and free of other recognized health hazards. Conform to the following:
   1. Surface texture: Textured Loop Pile..
   2. Pile fiber: Nylon.
   3. Pile weight: 16 oz per sq yd minimum.
   4. Pile density: 4,500 minimum.

5. Laying Pattern: Receive approval from Owner for laying pattern for all carpet tile.
6. Width: 24 inch by 24 inch.

B. Surface Texture:
1. Loop Pile:
a. Plain Surface: Provide either single level uncut pile or textured uncut pile to create an overall nondirectional surface. Maximum differential between finished pile heights (high and low pile loops of textured pile shall be 0.125 inch.

C. Pile Yarn: Do not use reclaimed yarn fibers from any woven, tufted, knitted, or felted products. Do not use undrawn fiber in spun yarn. Provide spun yarn at least two ply for loop pile carpets with sufficient twist to develop adequate yarn characteristics to ensure high wearability and to minimize pilling and fuzzing of the finished carpet. Provide plied yarns with a twist in the opposite direction to the singles. Use yarn setting method sufficient to assure permanent texture retention under normal use conditions, cleaning, and shampooing. Fiber denier and staple lengths may be subject to normal manufacturing tolerances with the following limitations: Acceptable variance in staple length plus or minus 10 percent. Acceptable denier variance, plus or minus 10 percent in individual filament denier and plus or minus 3 percent in average denier.
1. Blends: Provide fiber blend which combine not more than two fibers listed below and not less than 15 percent of either fiber. Treat acrylic and modacrylic fibers blended together as a single fiber type. The major component of a blend is the governing fiber in construction interpretation, except for weight. For example, treat a construction of 70 percent wool and 30 percent nylon as wool. Do not add more than 3 percent metallic filaments or other materials to blends to reduce static propensity.
2. Twist and Twist Multiplier: For loop-pile carpet, ASTM D1423.
3. Continuous Filament Polypropylene Olefin: Continuous-filament high-bulk or textured carpet fiber with average filament size of 15 denier or coarser.
4. Extractable Matter in Finished Yarn: ASTM D2257. Not more than 2 percent extracted using a single solvent, as follows:
a. Nylon-cylohexane;
b. Acrylic-chloroform;
c. Modacrylic-ether or HH Solvent;
d. Polypropylene cold isopropanol; and
e. Polyester-freon/ethanol azeotrope (96.2 percent 1,2,2-trichloro-1,2,2-trifluoroethane and 3.8 percent ethanol).

D. Backing Material: Those customarily used and accepted by the trade for each type of carpet.

2.02 PERFORMANCE REQUIREMENTS

A. Shrinkage: FS DDD-C-0095. Except that maximum shrinkage of length and width shall be 3 percent.

B. Colorfastness to Light: AATCC 16E. Use the Xenon arc as the light source. Consider colors that are deeper or equivalent in hue to Row 2 of the AATCC Color Transference Chart as dark colors; consider those lighter as light colors. Colors for synthetic yarns show a gray scale rating of at least 4 for light shades after the equivalent of two L-4 breaks and at least 4 for dark shades after the equivalent of at least three L-4 breaks.

C. Dry and Wet Crocking: AATCC 8. Minimum rating of step 4 on the AATCC Color Transference Chart for all colors specified.

D. Pile Coverage: Sufficient to conceal backing.

E. Tuft Bind: ASTM D1335. Provide minimum tuft bind in average pounds-force of 12 pounds for loop pile.

F. Flammability: CPSC 16 CFR 1630, all carpet shall comply. ASTM E648; all carpet shall comply as follows: ASTM E648, minimum average critical radiant flux of 0.25 watts per square centimeter. If attached cushion is specified, test carpet and cushion together as they will be installed. If separate underlay is specified, test carpet over the actual cushion used, as they will be installed.

G. Static Control: AATCC 134. Incorporate a permanent static control system to control static build-up to less than 3.5 kV. Test at 20 percent relative humidity at 70 degrees F.

H. Electrical Resistance: NFPA 99, Chapter 3. Maximum electrical resistance for carpet shall be 20,000 megohms measured between the floor surface and building or applicable ground material and a resistance of not less than 150 kilohms when measured from any point on the floor.

2.03 CALCULATION OF PHYSICAL REQUIREMENTS

A. Pile Weight: ASTM D418. Determine the average pile weight in ounces per square yard, except that pile weight of unsheared carpet may be determined by dissecting specimens taken from unfinished carpet before a back coating is applied. Unsheared carpet includes those which are tip sheared or defuzzed in a shearing operation where loss of fiber is negligible. Determination by dissecting specimens is only valid to the extent that it completely represents the pile weight of the fully finished carpet. In determining pile weights, make no allowance for the inclusion of any fibers needled or flocked onto or into the primary backing prior to tufting or weaving, or to any such process which is designed primarily to increase the total yarn weight and which is not integrally a part of the knitting,

weaving, or tufting manufacturing process. In the event of variance in results between ASTM D418 and the dissection method, the former prevails.

B. Percent of Fibers in Blend: AATCC 20A. Determine the average percent of fibers in a blend.

C. Pile Weight of Blend: Determine the pile weight of a blend by multiplying the average percent of each fiber by pile weight and totaling the result. For example, the weight of a blend of 30 percent nylon and 70 percent wool with yarn weights of 24 and 35 oz per sq yd respectively, shall be calculated as follows:

Nylon	0.30 X 24	=	7.2 oz per sq yd
Wool	-0.70 X 35	=	24.5 oz per sq yd-
Total weight			31.7 oz per sq yd

D. Pile Thickness: ASTM D418. Determine the average pile thickness of the carpet. Make measurements to the nearest 0.01 inch instead of 0.10 inch as stated in ASTM D418.

E. Pile Density: Calculate the average density (D) as follows:

$$D = \frac{-36\ (W)}{T}$$

Where: W = average pile weight in oz per sq yd
T = average pile thickness in inches.

2.04 MOLDING

A. Heavy-duty vinyl designed for the type of carpet being installed. Use floor flange at least 2 inches wide.

2.05 ADHESIVES

A. Waterproof, nonflammable, carpet latex release adhesive system designed to facilitate easy removal of carpet at a later date as furnished or recommended by the carpet manufacturer. Use waterproof, nonflammable, and nonstaining seal adhesive as furnished or recommended by the carpet manufacturer.

2.06 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the carpet manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install carpet after the work of other trades, including painting, is substantially done. Installed carpet must be smooth, uniform, and secure with a minimum of seams. Run side seams toward the light where practical and where such layout does not increase the number of seams. Install breadths parallel with carpet pile in the same direction. Match patterned goods according to manufacturer's recommendations. Fit cutouts such as door jambs, columns, and ducts. Locate carpet seams at doorways parallel to and centered directly under doors. Do not seam at doorways perpendicular to door or at pivot points. Follow the wall line parallel to the carpet direction for seams at corridor changes of direction.

1. Carpet Sheet, Direct-Glue-Down Installation: Comply with CRI Carpet Installation Standard, Section 13, “Direct Glue-Down Installation”.
    a. Carpet Sheet, Stair Installation: Comply with CRI Carpet Installation Standard, Section 17, “Carpet on Stairs” for glue-down installation.
    b. Comply with carpet sheet manufacturer’s written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
2. Carpet Tile: Comply with CRI Carpet Installation Standard, Section 18, “Modular Carpet” and with carpet tile manufacturer’s written installation instructions.
    a. Installation method, for Adhesive: Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive.
    b. Carpet Tile Pattern: As directed by Architect.
    c. Maintain dye lot integrity. Do not mix dye lots in same area.
3. Install pattern parallel to walls and borders.
4. Do not bridge building expansion joints with carpet.
5. Cut and fit carpet 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 manufacturer.
6. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
7. 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.

B. Carpet Location: Install carpet wall to wall in rooms and areas indicated on drawings. Include all material indicated, specified, or necessary for a completely finished installation by the installation method specified. Contractor is responsible for the required quantities of carpet and must verify all dimensions in the field as well as other conditions affecting the work.

C. Substrate Preparation: Inspect rooms and areas to be carpeted. Before installation, verify that concrete floors comply with requirements on moisture content as recommended by adhesive or carpet manufacturer's instructions. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Grind ridges smooth and level. Provide floor free of any foreign materials and swept broom clean. Comply with requirements for conditioning adhesives and minimum floor temperature before, during, and after installation as recommended by the carpet and adhesive manufacturers' instructions. However, in no case may floor temperature be less than 60 degrees F for 24 hours prior to, during, and after installation. Do not permit traffic or movement of furniture or equipment in carpeted areas for at least 24 hours after installation. Carpet installation constitutes validation by the Contractor that the substrate and conditions in the area meet all requirements for satisfactory installation.

3.02 INSTALLATION METHODS

A. Direct Glue-Down Without Cushion: Install in accordance with the carpet manufacturer's printed instructions.

B. Carpet Seams: Make uniform, unnoticeable, and permanent seams by any of the methods specified below, except when the carpet manufacturer specifies the seaming method. Treat all joining edges, regardless of seaming method, with a seam adhesive. Seams must have a minimum breaking strength of 100 pounds per inch and must be capable of withstanding all carpet cleaning processes.
   1. Hot-Melt Tape Seam: Use a hot-melt system, compatible with the carpet backing and back coating. Seam in accordance with the tape manufacturer's directions using first quality, minimum 4-inch wide hot melt tape. Control iron temperature to protect carpet and carpet cushion.

C. Molding: Finish carpet edges meeting hard surface flooring with moldings. Install according to manufacturer's instructions.

3.03 USABLE WASTE PIECES

A. Leave selected pieces at the site in an orderly manner, as directed by the Engineer. Remove all other waste pieces.

3.04 CLEANING AND PROTECTION

A. Cleaning: After installation, remove all debris, moldings, scraps, and other foreign matter. Remove any soiled spots or adhesive from the face of the carpet with the appropriate spot remover recommended by the carpet manufacturer. Clip any protruding face yarn with sharp scissors. Vacuum the carpet until it is clean.

B. Protection: Protect installed carpet with heavy, reinforced, nonstaining kraft building paper or polyethylene film of an approved quality and thickness. Lap and secure edges of covering widths. Keep covering in repair and replace damaged portions. Leave protective covering in place, as directed by the Engineer. Protect installed carpet to comply with CRI Installation Standard, Section 20, “Protecting Indoor Installations.”

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Painting as shown on the Plans, as specified and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Code of Federal Regulations (CFR) Publications:
      a. 29 1910.1000 - Occupational Safety and Health Standards
      b. 29 1910.1025 - Occupational Safety and Health Standards (Lead)
   2. Federal Standard (FED-STD):
      a. 313 - Material Safety Data Sheets Preparation and Submission of
   3. Steel Structures Painting Council (SSPC) Publications:
      a. Paint-1 - Shop, Field, and Maintenance Painting
      b. Paint-3 - A Guide to Safety in Paint Application
      c. Paint-20 - Zinc-Rich Primers (Type I, Inorganic, and Type II Organic)
      d. SP 1 - Solvent Cleaning
      e. SP 2 - Hand Tool Cleaning
      f. SP 3 - Power Tool Cleaning
      g. SP 6 - Commercial Blast Cleaning
      h. SP 7 - Brush-Off Blast Cleaning
      i. SP 10 - Near-White Blast Cleaning
      j. VIS1 - Pictorial Surface Preparation Standards for Painting Steel Surfaces.

1.03 SUBMITTALS

A. Submit the following.
   1. Manufacturer's Instructions:
      a. Paint application instructions
      b. Manufacturer's material safety data sheets

1) Submit Manufacturer's material safety data sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.04 REGULATORY REQUIREMENTS

A. Lead Content: Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

B. Chromate Content: Do not use coatings containing zinc-chromate or strontium-chromate.

C. Asbestos Content: Materials shall not contain asbestos.

1.05 DELIVERY AND STORAGE

A. Deliver materials in sealed, labeled containers bearing the manufacturer's name, brand designation, specification number, batch number, color, and date of manufacture. Restrict storage and mixing of materials to locations designated by the Engineer.

1.06 SAFETY METHODS

A. Apply coating materials using safety methods and equipment in accordance with the following:

B. Safety Methods Used During Coating Application: Comply with the requirements of SSPC Paint-3.

C. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:
1. The chemical manufacturer when using mineral spirits, or other chemicals. Use impermeable gloves, chemical goggles or face shield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct work in a manner to minimize exposure of building occupants and the general public.
2. The appropriate OSHA standard in 29 CFR 1910.1025 for surface preparation on painted surfaces containing lead, zinc-chromate, strontium-chromate, asbestos, or other toxic ingredients.
3. 29 CFR 1910.1000.
4. Threshold Limit Values (R) of the American Conference of Governmental Industrial Hygienists.
5. Manufacturer's Material Safety Data Sheets (MSDS).

1.07 ENVIRONMENTAL CONDITIONS

A. Exterior Coatings: Do not apply coating to surfaces during foggy or rainy weather, or under the following surface temperature conditions:

1. Less than 5 degrees F above the dew point;
2. Below 40 degrees F (for oil-based paints), 50 degrees F (for latex paints), or over 95 degrees F, unless approved by the Engineer.

B. Interior Coatings: Apply coatings when surfaces to be painted are dry and the following surface temperatures can be maintained:
1. Between 65 and 95 degrees F during the application of enamels and varnishes;
2. Between 50 and 95 degrees F during the application of other coatings.

1.08 COLOR SELECTION

A. Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Engineer.

1.09 LOCATION AND SURFACE TYPE TO BE PAINTED

A. Painting Included: Where a space or surface is indicated to be painted, include the following unless indicated otherwise.
1. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
2. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
3. Existing coated surfaces that are damaged during performance of the work.

B. Painting Excluded: Do not paint the following unless indicated otherwise.
1. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
2. Surfaces in concealed spaces. Concealed spaces are defined as spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, and chases.
3. Steel to be embedded in concrete.
4. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

C. Exterior Painting: Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the building site work items and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

D. Interior Painting: Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

1. Exposed columns, girders, beams, joists, and metal deck; and
2. Other contiguous surfaces.

E. Mechanical and Electrical Painting: Includes field coating of interior and exterior new and existing surfaces.
   1. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
      a. Exposed piping, conduit, and ductwork;
      b. Supports, hangers, air grilles, and registers;
      c. Miscellaneous metal work and insulation coverings.
   2. Do not paint the following, unless indicated otherwise:
      a. New zinc-coated, aluminum, and copper surfaces under insulation;
      b. New aluminum jacket on piping; and
      c. New interior ferrous piping under insulation.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS OF PAINT MATERIALS:

A. Products shall comply with MPI standards indicated and shall be listed in the "MPI Approved Product List."

2.02 MATERIALS

A. Provide as far as practical, pretreatments, primers and top coats from one coating manufacturer. Coatings shall be applied as a complete system and must be compatible with the substrate and each coating component. Coating systems shall be the manufacturer's industrial or commercial systems and are specified by generic type only. Residential coating systems shall not be permitted.

B. See painting schedule at the end of this Section.

C. Provide brands and qualities of materials for use on work exactly as specified, or an approved equal.

D. Coordination: Provide finish coats which are compatible with prime paints used. Provide barrier coats over incompatible primers where required. Submit written notification of anticipated problems using specified coatings with substrates primed by others.

E. Paint Colors:
   1. Provide colors as indicated or selected by Owner.
   2. Paint area of each color for observation, review and revisions before batch mixing of colors, or shipping large quantities of that color to job. Allow revisions to approved colors and textures after review of initial area of each color.
      a. Vary top coats in shade from preceding coat without affecting finish color.

F. Mixing and Tinting:
   1. Job mix or job tint only if approved. Mix only in pails in suitably sized non-ferrous or oxide-resistant metal pans.
   2. Strain to remove lumps and specks.
   3. Use tinting colors recommended by manufacturer for the specific type of finish.
   4. Add non-mercuric fungicidal agent to exterior finishes by manufacturer.

PART 3 - EXECUTION

3.01 PROTECTION OR AREAS AND SPACES

A. Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.02 SURFACE PREPARATION

A. Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other substances deleterious to coating performance as specified for each substrate.

B. Existing Coating Surfaces With No Defects: Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:
   1. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, FS TT-T-291. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

2. Sand existing enamel and other glossy surfaces to remove gloss. Brush and wipe clean with a dry cloth.
3. The requirements specified are minimum. Comply also with the instructions and recommendations of the paint manufacturer for preparation and application.

C. Existing Coated Surfaces with Minor Defects: Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings.

D. Removal of Existing Coatings: Remove existing coatings from the following surfaces:
1. Surfaces containing large areas of minor defects;
2. Surfaces containing more than 20 percent peeling area; and
3. Surfaces designated by the Engineer, such as surfaces where rust shows through existing coatings.

E. Substrate Repair:
1. Repair substrate surface damaged during coating removal;
2. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and
3. Clean and prime the substrate as specified.

3.03 PREPARATION OF METAL SURFACES

A. Existing and New Ferrous Surfaces:
1. Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2 or SSPC SP 3.
2. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6.
3. Galvanized steel shall be prepared for painting in accordance with ASTM D6386.
4. Immersed Surfaces to Receive a Coating: Clean in accordance with SSPC SP 10.

B. Final Ferrous Surface Condition: Cleaned surface shall be similar to photographs in SSPC VIS1 as follows:

DEGREE OF CLEANING	ADHERENT MILL SCALE	RUSTING MILL SCALE	RUSTED	PITTED AND RUSTED
Hand Tool Cleaning SSPC SP 2	(1)	B St 2	C St 2	D St 2
Power Tool Cleaning SSPC SP 3	(1)	B St 3	C St 3	D St 3
Commercial Blast Cleaning SSPC SP 6	(1)	(1)	C Sa 2	D Sa 2
Brush-Off Blast Cleaning SSPC SP 7	(1)	B Sa 1	C Sa 1	D Sa 1
Near White Blast Cleaning SSPC SP 10	A Sa 2-1/2	B Sa 2-1/2	C Sa 2-1/2	D Sa 2-1/2
Note: (1) No photograph is available or recommended for comparison.				

3.04 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

A. Concrete and Masonry:

1. Surface Cleaning: Remove the following deleterious substances.

a. Dirt, Chalking, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, and 3 quarts of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

b. Fungus and Mold: Wash, existing coated, and existing uncoated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

c. Glaze and Loose Particles: Remove by wire brushing.

d. Efflorescence: Remove by scraping or wire brushing followed by washing with a 5- to 10-percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

e. Removal of Existing Coatings: For surfaces to receive textured coating FS TT-C-555, remove existing coatings including soundly adhered coatings if recommended by textured coating manufacturer.

1) Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

B. Gypsum Board:
   1. Surface Cleaning: Gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material.
   2. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with spackling compound and sand smooth.

3.05 PREPARATION OF WOOD AND PLYWOOD SURFACE

A. New, Existing Uncoated, and Existing Coated Surfaces, Except Floors:
   1. Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Engineer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.
   2. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
   3. Cosmetic Repair of Minor Defects:
      a. Knots and Resinous Wood and Fire, Smoke, Water, and Color Marker Stained Existing Coated Surface: Prior to application of paint, treat with an application of commercially available knot sealer.
      b. Open Joints and Other Openings: Fill with whiting putty. Sand smooth after putty has dried.
      c. Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.
   4. Prime Coat For New Exterior Surfaces: Prime coat before wood becomes dirty, warped, or weathered.
   5. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

3.06 APPLICATION

A. Coating Application: Apply coating materials in accordance with SSPC Paint-1. SSPC Paint-1 methods are applicable to all substrates, except as modified herein. Thoroughly work coating materials into joints, crevices, and open spaces. Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.
   1. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying. Provide each coat in specified condition to receive the next coat.

2. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by the manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover the surface of the preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
3. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

B. Equipment: Apply coatings with approved brushes, approved rollers, or approved spray equipment, unless specified otherwise. Spray areas made inaccessible to brushing by items such as ducts and other equipment.

C. Thinning of Paints: Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory for the type of paint being used. Obtain written permission from the Engineer to use thinners. The written permission shall include quantities and types of thinners to use.

D. Coating Systems:
1. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table	
I	Exterior Metal Surfaces
II	Interior Metal Surfaces
III	Exterior Concrete Surfaces
IV	Interior Concrete Surfaces
V	Exterior Masonry Surfaces
VI	Interior Masonry Surfaces
VII	Interior Gypsum Wallboard Surfaces
VIII	Exterior and Interior Wood Surfaces

2. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.
3. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.
4. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
   a. One coat of primer.
   b. One coat of undercoat or intermediate coat.

c. One top coat to match adjacent surfaces.

5. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers, fillers, and primers need not be provided on surfaces where existing coatings are soundly adhered and in good condition.

3.07 COATING SYSTEMS FOR METAL

A. Primer: Apply specified ferrous metal primer on the same day that surface is cleaned. If flash rusting occurs, re-clean the surface prior to application of primer.

1. Inaccessible Surfaces: Prior to erection, use two coats of the specified primer on metal surfaces that will be inaccessible after erection.
2. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
3. Pipes and Tubing: The semitransparent film applied to pipes and tubing at the mill is not to be considered a shop coat. Apply specified ferrous metal primer prior to application of subsequent coats.
4. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces: On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer.
   a. Apply coatings of Tables I and II. "DFT" means dry film thickness in mils.

3.08 COATING SYSTEMS FOR WOOD AND PLYWOOD

A. Apply coatings of Tables VII and VIII.

B. Prior to erection, apply two coats of the specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

3.09 INSPECTION AND ACCEPTANCE

A. In addition to meeting the previously specified requirements, demonstrate the mobility of moving components, including but not limited to swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Engineer. Perform this demonstration after appropriate curing and drying times of the coatings have elapsed and prior to invoicing for final payment.

TABLE I
EXTERIOR METAL SURFACES

CONDITION	PREPARATION	FIRST COAT	DFT	SECOND COAT	DFT	THIRD COAT	DFT
Severe	SSPC SP 6	Epoxy-	4.0	Aliphatic Polyester	1.5	-	-

TABLE I EXTERIOR METAL SURFACES							
		Polyamide		Polyurethane			
Mild	SSPC SP 6	Alkyd-Phenolic Primer	2.0	Alkyd	1.5	Alkyd	1.5

TABLE II INTERIOR METAL SURFACES							
CONDITION	PREPARATION	FIRST COAT	DFT	SECOND COAT	DFT	THIRD COAT	DFT
Severe	SSPC SP 6	Epoxy-Polyamide Primer	3.0	Epoxy-Polyamide	4.0	-	-
Mild	SSPC SP 6	Alkyd-Phenolic Primer	2.0	Alkyd	1.5	Alkyd	1.5
Immersion	SSPC SP 10	Coal-Tar Epoxy	14.0	-	-	-	-

TABLE III EXTERIOR CONCRETE SURFACES							
CONDITION	PREPARATION	FIRST COAT	DFT	SECOND COAT	DFT	THIRD COAT	DFT
Severe	Clean and Dry	Modified Epoxy	8.0	-	-	-	-
Mild	Clean and Dry	Emulsified Acrylic	2.0	Emulsified Acrylic	2.0	-	-

TABLE IV INTERIOR CONCRETE SURFACES							
CONDITION	PREPARATION	FIRST COAT	DFT	SECOND COAT	DFT	THIRD COAT	DFT
Severe	Brush Blast	Epoxy-Polyamide Water-Borne	4.0	Epoxy-Polyamide Water-Borne	4.0	-	-
Moderate	Brush Blast	Acrylic-Epoxy	2.0	Acrylic-Epoxy	2.0	--	-
Mild	Clean and Dry	Emulsified Acrylic	2.0	Emulsified Acrylic	2.0	-	
Concrete Floors	Acid Etch or Brush Blast	Epoxy-Polyamide (skid resistant)	2.0	Epoxy-Polyamide	2.0	-	-

TABLE V EXTERIOR MASONRY SURFACES							
CONDITION	PREPARATION	FIRST COAT	DFT	SECOND COAT	DFT	THIRD COAT	DFT
All	Clean and Dry	Modified Epoxy	60 sf/gal	Modified Epoxy	8.0	-	-

TABLE VI INTERIOR MASONRY SURFACES							
CONDITION	PREPARATION	FIRST COAT	DFT	SECOND COAT	DFT	THIRD COAT	DFT
Severe	Clean and Dry	Epoxy-Polyamide Filler	75 sf/gal	Epoxy-Polyamide	4.0	Epoxy-Polyamide	4.0
Mild	Clean and Dry	Modified Epoxy Filler	60 sf/gal	Emulsified Acrylic	2.0	Emulsified Acrylic	2.0

TABLE VII INTERIOR GYPSUM WALL BOARD SURFACES							
CONDITION	PREPARATION	FIRST COAT	DFT	SECOND COAT	DFT	THIRD COAT	DFT
Severe	Clean and Dry	Vinyl-Acrylic Latex Sealer	1.0	Epoxy-Polyamide	4.0	Epoxy-Polyamide	4.0
Moderate	Clean and Dry	Vinyl-Acrylic Latex Sealer	1.0	Water-Borne Acrylic-Epoxy	2.0	Water-Borne Acrylic-Epoxy	2.0
Mild	Clean and Dry	Emulsified-Acrylic	2.0	Emulsified-Acrylic	2.0	-	-

TABLE VIII EXTERIOR AND INTERIOR WOOD SURFACES							
CONDITION	PREPARATION	FIRST COAT	DFT	SECOND COAT	DFT	THIRD COAT	DFT
All	Clean and Dry	Alkyd Primer	2.0	Alkyd	1.5	Alkyd	1.5

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Signage, as shown on the Plans, as specified and/or directed including plaques, panel signs and illuminated panel signs.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Federal Specifications (Fed. Spec.):
      a. L-P-387a - Plastic Sheet, Laminated, Thermostatting (for design plates)
      b. FF-B-588C (1) - Bolt, Toggle, and Expansion Sleeve, Screw
   2. Military Specification (Mil. Spec.):
      a. MIL-M-437l9B - Marking Materials and Markers, Adhesive, Elastomeric, Pigmented; General Specification for
   3. The Aluminum Association (AA) Publications:
      a. Standards for Anodized Architectural Aluminum
      b. Designation System for Aluminum Finishes
   4. American National Standards Institute (ANSI) Publications:
      a. B18.6.2 - Slotted Head Cap Screws, Square Head Set Screws and Slotted Headless Set Screws
      b. B18.6.3 - Machine Screws and Machine Screw Nuts
   5. American Society for Testing and Materials (ASTM) Publications:
      a. A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip
      b. A153 - Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
      c. A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products
      d. B26 - Aluminum-Alloy Sand Castings
      e. B108 - Aluminum-Alloy Permanent Mold Castings
      f. B209 - Aluminum and Aluminum-Alloy Sheet and Plate
      g. B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

1.03 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for signs.
   1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
   3. Wiring Diagrams: Power, signal and control wiring.

C. Samples for Verification: For each of the following products and for the full range of color, texture, and sign material indicated, of sizes indicated:
   1. Plaque Casting: 6 inches square including border.
   2. Aluminum: For each form, finish, and color, on 6-inch long sections of extrusions and squares of sheet at least 4 by 4 inches.
   3. Acrylic Sheet: 8 by 10 inches for each color required.
   4. Polycarbonate Sheet: 8 by 10 inches for each color required.
   5. Fiberglass Sheet: 8 by 10 inches for each color required.
   6. Panel Signs: Not less than 12 inches square including border.
   7. Trim: 6 inch long sections of each profile.
   8. Accessories: Manufacturer's full-size unit.

D. Sign Schedule: Use same designations indicated on drawings.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: for fabricator.

B. Warranty: Special warranty specified in this Section.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in service performance.

C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.

D. Regulatory Requirements: Comply with applicable provisions in ADA ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.07 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on shop drawings.

1.08 COORDINATION

A. Coordinate placement of anchorage devices with templates for installing signs.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

B. Failures include, but are not limited to, the following:
   1. Deterioration of metal and polymer finishes beyond normal weathering.
   2. Deterioration of embedded graphic image colors and sign lamination.

C. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 LOCATIONS

A. Provide signage as required in the flowing reference standards.
   1. International Building Code (applicable version): Chapter 11 Accessibility.
   2. International Fire Code (applicable version).
   3. ADA-ABA Accessibility Guidelines (applicable version).

B. Coordinate exact locations and quantities with signage vendor as required.

2.02 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.

C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.

D. Fiberglass Sheet: Molded, seamless, thermosetting, glass-fiber-reinforced polyester panels with a minimum tensile strength of 15,000 psi when tested according to ASTM D 638 and with a minimum flexural strength of 30,000 psi when tested according to ASTM D 790.

E. Acrylic Sheet: ASTM D 4802, Category A□1 (cell-cast sheet), Type UVA (UV absorbing).

F. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, coated on both surfaces with abrasion-resistant coating:
1. Impact Resistance: 16 ft-lbf/in. per ASTM D256, Method A.
2. Tensile Strength: 9,000 lbf/sq. in. per ASTM D638.
3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D790.
4. Heat Deflection: 265 deg F at 264 lbf/sq. in. per ASTM D648.
5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.

G. Applied Vinyl: Die-cut characters from vinyl film of nominal thickness of 3 mils with pressure-sensitive adhesive backing, suitable for exterior applications.

2.03 PANEL SIGNS

A. Manufacturers: Provide a manufacturer able to comply with the requirements of the specifications.

B. Interior and Exterior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:
1. High-Pressure Decorative Laminate: 0.048 inch thick.
2. Laminated, Etched Photopolymer: Raised graphics with Braille 1/32 inch above surface with contrasting colors in finishes and color combinations indicated and laminated to acrylic back or aluminum alloy.

3. Edge Condition: Square cut.
4. Corner Condition: Square.
5. Mounting: Manufacturer’s standard anchors for substrates encountered.
6. Paint Colors: As selected by Owner from manufacturer’s range of color options.

7. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.

C. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit panel sign construction and mounting conditions indicated. Factory paint brackets in color matching background color of panel sign.

D. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Owner.
1. Furnish insert material and software for creating text and symbols for PC-Windows computers for Owner production of paper inserts.
2. Furnish insert material cut-to-size for changeable message insert.

E. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

F. Engraved Copy: Machine engrave letters, numbers, symbols, and other graphic devices into panel sign on face indicated to produce precisely formed copy, incised to uniform depth.
1. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
2. Engraved Metal: Fill engraved copy with enamel.

2.04 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.05 FABRICATION

A. General: Provide manufacturer's standard signs of configurations indicated.
1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
3. Preassemble signs in the shop to greatest extent possible. Dissemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.

4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.06 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.07 ALUMINUM FINISHES

A. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish, complying with AAMA 611.

B. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
   1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils, medium gloss.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items, including anchor inserts, are sized and located to accommodate signs.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
   1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
   1. Two-Face Tape: Mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.
   2. Mechanical Fasteners: Use non-removable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
   3. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.
   4. Bracket-Mounted Signs: Provide manufacturer's standard brackets, fittings, and hardware for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls and ceilings with concealed fasteners and anchoring devices to comply with manufacturer's written instructions.

3.03 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner

END OF SECTION

SECTION 10 26 41

BULLET RESISTANT PANELS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Bullet Resistant Fiberglass UL 752 Level 3, as shown on the Plans, as specified and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publication:
      a. E119-98 Standard Test for One-Hour Fire-Rating of Building Construction and Materials
   2. Underwriters Laboratories, Inc. (UL) Publication:
      a. 752 10th Edition, Standard for Bullet Resisting Equipment dated March 10, 2000

1.03 SUBMITTALS

A. The following shall be submitted in accordance with Sections13070 and the SPECIAL CONTRACT REQUIREMENTS: Submit for approval prior to fabrication samples, brochures, specifications, **UL LISTING Verification** and **UL752 Current Test Results** as provided by Underwriters Laboratories, and printed data in sufficient detail to indicate compliance with the contract documents. ASTM E119-98 One-Hour Fire Rating of Building Construction and Materials. Manufacturer's Instructions for installation of Bullet Resistant Fiberglass Panels.

1.04 DESIGN

A. Through the design, manufacturing technique and material application the Bullet Resistant Fiberglass shall be of the "non ricochet type". This design is intended to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver the materials to the project with the manufacturer's **UL LISTED Labels** intact and legible. Handle the material with care to prevent damage. Store the materials inside under cover; stack flat and off the floor.

1.06 WARRANTY

A. All materials and workmanship shall be warranted against defects for a period of one (1) year from the date of receipt at the project site.

PART 2 - PRODUCTS

2.01 BULLET RESISTANT FIBERGLASS MATERIAL

A. The panels shall be made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets. The production technique and materials used shall provide the controlled internal delamination to permit the encapture of a penetrating projectile. Bullet Resistant Fiberglass panels: 7/16" maximum thickness and 4.7 pounds per square foot maximum weight.

B. Material shall be supplied by Advanced Protection products Inc., Toll Free (866) 300-5122, Fax # (519) 893-7855, Email:info@advancedprotectionproducts.com, or approved equal.

2.02 SECURITY LEVEL

A. The Bullet Resistant Fiberglass will be rated and tested for UL752 **Level 3**.

PART 3 - EXECUTION

3.01 SUPPORTING MEMBERS

A. Prior to installing the bullet resistive material the contractor shall verify that all supports have been installed as required by the contract documents and the architectural drawings.

3.02 JOINTS

A. All joints shall be reinforced by a back-up layer of bullet resistive material. The bullet resistance of the joint, as reinforced, shall be at least equal to that of the panel. Minimum width of reinforcing layer at joint shall be 4-inches (2" on each panel or a 2" minimum overlap).

3.03 APPLICATION

A. Armor shall be installed in accordance with the manufacturer's printed recommendations. Armor panels shall be adhered using an industrial adhesive, mastic, screws or bolts. Method of application shall maintain the bullet resistive rating at junctures with the concrete floor slab, the concrete roof slab, the bullet resistive door frames, the bullet resistive window frames, and all required penetrations.

END OF SECTION

SECTION 10 28 13

TOILET ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Toilet Accessories, as shown on the Plans, as specified and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Commercial Item Description (CID) Publication:
      a. A-A-2380 - Dispenser, Paper Towel
   2. Federal Specifications (Fed. Spec.):
      a. W-H-50B - Hand Drier, Blower, Electric
      b. DD-M-00411B - Mirrors, Glass
      c. RR-A-1255C - Ash Receiver, Tobacco (Wall Mounted, Paraboloidal Shape, 2-Quart Capacity)
      d. WW-D-1908A - Dispenser, Toilet Paper, Cabinet
      e. WW-H-1911A - Holder, Toilet Paper (Single Roll)
      f. WW-P-541/8B - Plumbing Fixture (Accessories, Land Use) (Detail Specification)

1.03 SUBMITTALS

A. Manufacturer's Catalog Data: Submit for each type of accessory specified. Include descriptions of materials, finishes, fastening and anchoring devices, and appurtenances.

B. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware and installation procedures.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated on drawings.
   2. Identify products using designations indicated on drawings.

1.04 DELIVERY AND STORAGE

A. Deliver materials to the site in unopened containers, labeled with the manufacturer's names and brands, ready for installation. Store accessories in safe, dry locations until needed for installation.

1.05 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustments, operation, cleaning and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying Work.

PART 2 - PRODUCTS

2.01 MATERIALS AND FABRICATION

A. Fabricate accessories in accordance with commercial practice, with welds ground smooth. Bend, flange, draw, form, and perform similar operations in a manner to ensure no defects. Flanges of recessed accessories to return to walls to provide a continuous, tight-against-the-wall installation. Doors shall be warp free. Key manufacturer's standard locks alike, for groups of accessories; two keys furnished for each group.

2.02 FINISHES

A. Finishes on metals not specified otherwise shall be provided as follows:

Metal	Finish
Corrosion-resisting Steel	General-Purpose Polished (Stainless Steel)
Aluminum	Satin Anodic, Clear
Carbon Steel	Bright Chromium Plate
Copper Alloy (Brass)	Bright Chromium Plate
Zinc Alloy	Bright Chromium Plate

2.03 MANUFACTURED UNITS

A. Toilet Tissue Dispensers (Surface Mounted): Type: Surface-mounted hinged hood dual rail toilet tissue dispenser model 5126 by "Bradlex (or approved equal)".

B. Grab Bars: Fed. Spec. WW-P-541/8B, Type IV, Class 2, surface mounted, stainless steel, 1-1/4 inches in diameter, with a nominal wall thickness of not less than 0.50 inch (18 gauge), of the length and shape indicated, and with a non-slip finish. Grab bars and mounting devices shall be capable of withstanding a static load of 250 pounds at any point on the bar.

C. Soap Dispensers: Type: Model 6562 as manufactured by Bradley (or approved equal).

D. Combination Paper Towel Dispenser/Waste Receptacle Units: A recessed or semi-recessed type. Dispenser shall have a capacity of 400 sheets of any type paper towels. Waste receptacle shall be designed for locking in unit and removing for service. Waste receptacle shall have a capacity of 12 gallons. Units shall be fabricated from 22-gauge stainless steel welded construction with all exposed surfaces to have satin finish. Provide waste receptacle with reusable liner of the type standard with the unit manufacturer. Type: Model 235-000000 Paper Towel Dispenser & Waste Receptacle by Bradley (or approved equal).

E. Mirrors: ADA complaint. Type: 740 series tilt mirror as manufactured by Bradley (or approved equal).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Surfaces of fastening devices exposed after installation shall have the same finish as the attached accessory. Exposed screw heads shall be oval. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Brackets, plates, anchoring devices and similar items used for mounting accessories in showers shall be bedded in a sealant as specified in Section 07 92 00, "Sealants", as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work. Install grab bars to withstand downward load of at least 250 pound-force, when tested per method in ASTM F446. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Recessed Accessories: Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

C. Surface-Mounted Accessories: Mount on concealed backplates, unless specified otherwise. Accessories without backplates shall have concealed fasteners. Unless indicated or specified otherwise, install accessories with sheet metal screws or wood screws in lead-lined braided jute, Teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.02 CLEANING

A. Remove temporary labels and protective coatings.

B. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 10 44 00

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Fire Extinguishers, as shown of the Plans, as specified and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. The following is a list of standards which may be referenced in this Section:
1. Factory Mutual (FM).
2. Mine Safety and Health Administration (MSHA).
3. National Fire Protection Association:
4. 10, Standard for Portable Fire Extinguishers.
5. National Institute for Safety and Health (NIOSH): Certification Program.
6. Occupational Safety and Health Act (OSHA).
7. Underwriters Laboratories, Inc. (UL): Fire Protection Equipment List.
8. ASTM International: ASTM E814, Standard Test Method for Fire Tests of Penetration Firestop Systems.

1.03 SUMMARY

A. Section includes:
1. Fire extinguishers.
2. Brackets for wall mounting.
3. Projecting graphic identification signage.

B. Related work specified elsewhere:
1. Section 06 10 01, Rough Carpentry.
2. Section 09 91 00, Painting.

1.04 SUBMITTALS

A. Provide the following:
1. Action Submittals:
a. Fire Extinguishers: Submit manufacturer’s product data for each item, including sizes, UL listings, or other certifications and mounting information.

b. Product Data: Submit extinguisher operational features, color and finish, and anchorage details.

2. Informational Submittals:
   a. Manufacturer’s Installation Instructions:
      1) Special criteria and wall opening coordination requirements.
   b. Manufacturer’s Certificate: Certify Products meet or exceed specified requirements.
   c. Operation and Maintenance Data: Submit test, refill or recharge schedules and recertification requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site and inspect for damage.

B. Store and protect materials according to manufacturer's instructions.

C. Do not install extinguishers when ambient temperature is capable of freezing extinguisher contents.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Manufacturers:
   1. JL Industries
   2. Larsen’s Manufacturing Company
   3. Nystrom Products Company
   4. Potter Roemer
   5. Or Approved Equal

B. General:
   1. Conform to NFPA 10 for fire extinguishers.
   2. Furnish all fire extinguishers from one manufacturer.
   3. UL-listed, charged and ready for service.
   4. Provide ten (10) 10-lb fire extinguishers, with mounting bracket and graphic identification sign, as specified herein.

C. Multi-Purpose Hand Extinguisher (EXT-1):
   1. Tri-class dry chemical extinguisher agent.
   2. Pressurized, red enamel steel shell cylinder.
   3. Activated by top squeeze handle.
   4. Agent propelled through hose or opening at top of unit.
   5. For use on A, B, and C class fires.
   6. Minimum UL Rating: 4A:80B:C, 10-lb capacity.

2.02 ACCESSORIES

A. Extinguisher Brackets: For each extinguisher, furnish heavy-duty brackets with clip-together strap for wall-mounting formed steel, white enamel finish.

B. Graphic Identification Sign:
   1. Provide projecting graphic identification sign for each fire extinguisher furnished.
   2. Each sign shall use photo-luminescent material to remain illuminated during a power outage and shall comply with ASTM E2072.
   3. Sign shall include OSHA-approved pictorial markings to indicate the extinguisher uses and non-uses on a single label.
   4. Manufacturer: GlowSmart, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install where indicated or directed and in accordance with the manufacturer's recommendations.

B. Install brackets and graphic identification signs plumb and level on walls.

C. Install wall brackets maximum 48 inches from finished floor to top of extinguisher handle.

D. Secure cabinets rigidly in place.

E. Place extinguishers on wall brackets.

F. Position cabinet signage as required by AHJ.

END OF SECTION

SECTION 10 44 13

FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:
   a. Portable fire extinguisher.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

2.3 FIRE-PROTECTION CABINET FE

A. Cabinet Type: Suitable for fire extinguisher.

1. Larsen's Model 2712 Architectural Series, or Approved Equal

B. Cabinet Construction: Nonrated One-hour fire rated Two-hour fire rated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Aluminum sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet:

1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as drywall bead.
2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: Aluminum sheet Extruded-aluminum shapes Same material and finish as door.

H. Door Material: Aluminum sheet Extruded-aluminum shapes.

I. Door Style: Fully glazed panel with frame.

J. Door Glazing: Tempered float glass (clear).

1. Acrylic Bubble Color: Clear, transparent.

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide manufacturer's standard hinge, permitting door to open 180 degrees.

L. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Door Handle: Manufacturer's standard, integral to glass with the words "PULL TO BREAK GLASS" applied to handle.

M. Materials:

1. Aluminum: ASTM B221 for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.
   a. Finish: Baked enamel or powder coat.
   b. Color: As selected by Architect from full range of industry colors and color densities.
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated and at heights acceptable to authorities having jurisdiction.

1. Fire-Protection Cabinet Mounting Height: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
4. Fire-Rated Cabinets:
    a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
    b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

C. Identification:

1. Apply vinyl lettering.
2. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10 51 13

METAL LOCKERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Metal Lockers, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Military Specification (Mil. Spec.):
      a. MIL-W-12332 - Welding, Resistant, Spot and Projection for Fabricating Assemblies of Low-Carbon Steel
   2. Federal Specifications (Fed. Spec.):
      a. AA-L-00486H - Interim Federal Specification, Lockers, Clothing, Steel
      b. FF-P-101 - Padlocks
      c. TT-C-490 - Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings
      d. PPP-P-15 - Packaging and Packing of Storage Cabinets and Clothing Lockers, Metal

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical data, descriptive literature and installation instructions for metal locker units.

B. Shop Drawings: Submit shop drawings indicating elevations, thicknesses and gages of metals, fastenings, proposed method of anchoring, the size and spacing of anchors, details of construction, hardware, fittings, mountings and other related items and installation details.

C. Certificates of Compliance: Submit certificates from the manufacturer attesting that materials meet the requirements specified herein.

1.04 DELIVERY, STORAGE AND PROTECTION

A. Deliver materials to the site in original sealed containers or packages, bearing the manufacturer's name and brand designation conforming to requirements of Fed.

Spec. PPP-P-15. Store and handle materials in a manner to protect them from damage during the entire construction period.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Lockers shall meet requirements of AA-L-0486H Type I single-tier lockers (semi-louvered door). Size: 18 inches wide, 18 inches deep, 84 inches high overall, with a shelf located 9 to 10 inches below the locker top and coat hooks, one located on each side wall and one on the back wall.

1. Locker Body: Back and side walls shall be minimum 24 gage steel, with double-flanged connections extended full height. Form top and bottom panels of not less than 24 gage steel, with flanged edges.
2. Locker Shelf: 24 gage steel.
3. Locker Door: One piece, minimum 16 gage sheet steel, flanged at all edges, constructed to prevent springing when opening or closing. Fabricate to swing 180 degrees. Provide stamped, louvered vents in door face.
4. Locker Hinges: Heavy duty, not less than 0.050-inch thick steel, full loop, 5 knuckle, tight pin, 2 inches high. Weld to inside of frame and secure to door with not less than 2 factory-installed fasteners which are completely concealed and tamperproof when door is closed.
5. Locker Latching: Positive automatic, pre-locking, pry-resistant latch and pull with rubber silencers; chromium-plated, heavy duty, vandal-proof lift-up handle, containing strike and hole for padlock; and with mechanism three point latching conforming to requirements of Fed. Spec. FF-P-101.

B. Locker Accessories: Provide the following accessories for each unit:

1. Sloping Tops: Tops shall be not less than 20 gage sheet steel, approximately 25 degrees pitch, in lengths as long as practicable. Provide closures at all exposed ends. Finish to match lockers.
2. Filler Panels: Provide filler panels where required to close space between lockers and wall surface. Panels shall be not less than 16 gage steel sheet, factory fabricated and finished to match locker units.
3. Closed Base: Metal base shall be not less than 16 gage cold rolled steel, fabricated to enclose base of lockers without additional fastening devices. Flange bottoms inward 3/4 inch for stiffening. Factory finish metal base to match lockers.

C. Fabrication: Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make all exposed metal edges safe to touch. Weld frame members together to form rigid, one-piece structure in accordance with Mil. Spec. MIL-W-12332. Weld, bolt, or rivet other joints and connections as standard with manufacturer. Grind exposed welds flush. Do not expose bolts or rivet heads on front of locker doors or frames. Fabricate of 16 gage channels or 12 gage angles, minimum, with continuous stop/strike formed on vertical members. Chemically pretreat metal with degreasing and phosphatizing process in accordance with Fed. Spec. TT-C-490. Apply baked-on enamel finish to all surfaces, exposed and concealed, except plates and non-ferrous metal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install metal lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.

B. Space fastenings 48 inches on center, unless otherwise recommended by manufacturer, and apply through back-up reinforcing plates where necessary to avoid metal distortion; conceal fasteners where possible.

C. Install sloping top units, and metal filler panels where indicated, using concealed fasteners to provide flush, hairline joints against adjacent surfaces.

END OF SECTION

SECTION 12 32 16

MANUFACTURED PLASTIC LAMINATE-FACED CASEWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Plastic-laminate-faced cabinets.
   2. Sinks and plumbing fixtures associated with casework.
   3. Deal tray, used for security in front reception area

B. Related Requirements:
   1. Section 06 10 01 "Rough Carpentry" for wood blocking for anchoring casework.
   2. Section 09 22 16 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring casework.
   3. Section 09 65 13 "Resilient Base and Accessories" for resilient base applied to plastic- laminate-faced casework.
   4. Section 12 36 23.13 "Plastic-Laminate-Clad Countertops."

1.03 DEFINITIONS

A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.

B. MDF: Medium-density fiberboard.

C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.04 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.05 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.06 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples for Initial Selection: For cabinet finishes.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer that is certified for chain-of-custody by an FSC-accredited certification body.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project and who is a certified participant in AWI's Quality Certification Program.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period. Maintain temperature and relative humidity during the remainder of the construction period in range recommended for Project location by the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on shop drawings.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Delamination of components or other failures of glue bond.
      b. Warping of components.
      c. Failure of operating hardware.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 DEAL TRAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Creative Industries, Inc. Model FLR 1214 SL (Basis of Design).
   2. C R Laurence
   3. Safescan

2.02 CASEWORK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Case Systems.
   2. Stevens Industries, Inc.
   3. TMI Systems Design Corporation.
   4. Custom made in an independent cabinet shop.

B. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.

2.03 CASEWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.
1. Grade: Custom.

B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-faced cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations of same finish materials, and complying with the Specifications may be considered.

2.04 CASEWORK

A. Design:
1. Reveal overlay.

B. Grain Direction for Wood Grain Plastic Laminate:
1. Vertical on doors, horizontal on drawer fronts.
2. Lengthwise on face frame members.
3. Vertical on end panels.
4. Side to side on bottoms and tops of units.
5. Vertical on knee-space panels.
6. Horizontal on aprons.

C. Exposed Materials:
1. Plastic Laminate:
a. Grade HGS, 0.048-inch (1.22-mm), horizontal general purpose decorative grade.
b. Grade VGS, 0.028-inch (0.71-mm), vertical surface decorative grade.
c. Colors and Patterns: As indicated by manufacturer's designations.
2. Unless otherwise indicated, provide specified edge banding on all exposed edges.

D. Semi-exposed Materials:
1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.
a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
2. Unless otherwise indicated, provide specified edge banding on all semi-exposed edges.

E. Concealed Materials:
   1. Plastic Laminate: Grade BKL.

2.05 MATERIALS

A. Low-Emitting Materials: Fabricate casework, with adhesives and composite wood products containing no urea formaldehyde.

B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

C. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated made without urea formaldehyde.

D. Particleboard: ANSI A208.1, Grade M-2; made with binder containing no urea formaldehyde.

E. Hardboard: ANSI A135.4, Class 1 Tempered.

F. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Formica Corporation.
      b. Pionite, Panolam Industries International Inc.
      c. Nevamar, Panolam Industries International Inc.
      d. Wilsonart International.
      e. An approved equal.

G. Edge banding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.

H. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

I. Edge banding for Thermoset Decorative Panels: PVC or polyester edge banding matching thermoset decorative panels.

2.06 COLORS AND FINISHES

A. Thermoset Decorative Panel Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range.

B. Plastic-Laminate Colors, Patterns, and Finishes: As indicated by manufacturer's designations.

C. PVC Edge banding Color and Pattern: As selected from edge band manufacturer's full range.

2.07 FABRICATION

A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:
   1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard.
   2. Shelves: 1-inch- (25-mm-) thick particleboard.
   3. Backs of Cabinets: 1/2-inch- (12.7-mm-) thick particleboard or MDF where exposed, 1/4-inch (6.4-mm) hardboard dadoed into sides, bottoms, and tops where not exposed.
   4. Drawer Fronts: 3/4-inch (19-mm) particleboard.
   5. Drawer Sides and Backs: 1/2-inch (12.7-mm) particleboard or 5/8-inchMDF, with glued dovetail or multiple-dowel joints.
   6. Drawer Bottoms: 1/4-inch (6.4-mm) particleboard or MDF glued and dadoed into front, back, and sides of drawers. Use 1/2-inch (12.7-mm) material for drawers more than 24 inches (600 mm) wide.
   7. Doors: 3/4 inch (19 mm) thick, with particleboard or MDF cores.

B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.08 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
   1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Butt Hinges: Powder-coated, semi-concealed, five-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide two hinges for doors less than 48 inches (1220 mm) high, and provide three hinges for doors more than 48 inches (1220 mm) high.

C. Pulls: Solid aluminum wire pulls, fastened from back with two screws. Provide two pulls for drawers more than 24 inches (600 mm) wide.

D. Door Catches: Zinc-plated, nylon-roller spring catch or dual, self-aligning, permanent magnet catch. Provide two catches on doors more than 48 inches (1220 mm) high.

E. Drawer Slides: BHMA A156.9, Type B05091.
   1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides.

2. File Drawer Slides: Grade 1HD-200, for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.

F. Label Holders: Chrome plated, sized to receive standard label cards approximately 1 by 2 inches (25 by 51 mm), attached with screws or brads.
1. Provide label holders where indicated.

G. Drawer and Hinged Door Locks: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.
1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks on all doors and drawers.

H. Adjustable Shelf Supports: Two-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CASEWORK INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install casework level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm). Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

E. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

G. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.03 CLEANING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION

SECTION 12 36 23.13

PLASTIC LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes plastic laminate-clad countertops.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For plastic laminate-clad countertops.
   1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
   2. Show locations and sizes of cutouts and holes for items installed in plastic laminate-clad countertops.
   3. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: Plastic laminates in each type, color, pattern, and surface finish required in manufacturer's standard size.

D. Samples for Initial Selection: For plastic laminates.

E. Samples for Verification: As follows:
   1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10
      inches (200 by 250 mm) in size.
   2. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core material with specified edge material applied to one edge.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For the following:
   1. Composite wood and agrifiber products.
   2. High-pressure decorative laminate.
   3. Adhesives.

C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
   1. Shop Certification: AWI's Quality Certification Program accredited participant.

B. Installer Qualifications: AWI's Quality Certification Program accredited participant.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.07 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.01 FABRICATORS

A. Fabricators: Subject to compliance with requirements, available fabricators offering products that may be incorporated into the Work include, but are not limited to, the following:

2.02 PLASTIC LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
   1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
   2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Economy.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Formica Corporation.
      b. Pionite; a Panolam Industries International, Inc. brand.
      c. Wilsonart.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As indicated by manufacturer's designations.
   2. Match Architect's sample.

3. As selected by Architect from manufacturer's full range in the following categories:
    a. Solid colors, matte finish.
    b. Solid colors with core same color as surface, matte finish.

E. Edge Treatment: Same as laminate cladding on horizontal surfaces.

F. Core Material: Particleboard.

G. Core Material at Sinks: Particleboard made with exterior glue.

H. Core Thickness: 3/4 inch (19 mm).

I. Backer Sheet: Provide plastic laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

J. Paper Backing: Provide paper backing on underside of countertop substrate.

2.03 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
    1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.
    1. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
    2. Softwood Plywood: DOC PS 1.

2.04 ACCESSORIES

A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
        a. Doug Mockett & Company, Inc.
        b. Electriduct.
        c. Rockler.
    2. Outside Diameter: 1-1/4 inch (32 mm).
    3. Color: Black.

2.05 MISCELLANEOUS MATERIALS

A. Adhesive for Bonding Plastic Laminate: As selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.06 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch (25 mm) over base cabinets. Ease edges to radius indicated for the following:
   1. Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times countertop fabrication will be complete.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
   1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.01 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.02 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
   1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
   1. Secure field joints in countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches (3-mm-in-2400-mm) variation from a straight, level plane.
   2. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
   3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.03 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semi exposed surfaces.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Wet-Pipe Sprinkler Systems as shown on the Plans, as specified, and/or directed.

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
   1. American Society for Testing and Materials (ASTM) Publication:
      a. A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
      b. A120 – Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
   2. American Water Works Association, Inc. (AWWA) Publication:
      a. C104 – Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water
      b. C110 – Ductile-Iron and Gray-Iron Fittings, 3 inch Through 48 inch, for Water and Other Liquids
      c. C151 – Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
      d. C500 – Gate Valves, 3 inch Through 48 inch NPS, for Water and Sewage Systems
      e. C601 – Disinfecting Water Mains
   3. Factory Mutual System (FM) Publication:
      a. P7825 – Approval Guide
   4. Federal Specifications (FS) Publication:
      a. TT-E-489 – Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)
      b. TT-P-645 – Primer, Paint, Zinc Chromate, Alkyd Type
   5. Military Specifications (MIL) Publication:
      a. DOD-P-15328 – Primer (Wash), Pretreatment (Formula No. 117 for Metals) (Metric)
   6. National Fire Protection Association (NFPA) Publication:
      a. 13 – Sprinkler Systems
      b. 25 – Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
      c. 70 – National Electrical Code

d. 170 – Fire Safety and Emergency Symbols
e. 291 – Recommended Practice for Fire Flow Testing and Marking of Hydrants

7. NICET (National Institute for Certification in Engineering Technologies)
   a. Fire Protection Engineering Technology, Automatic Sprinkler System Layout, Program Detail Manual
8. Underwriters Laboratory, Inc. (UL) Publication:
   a. 262 – Gate Valves for Fire-Protection Service
   b. 789 – Indicator Posts for Fire-Protection Service
   c. FPED – Fire Protection Equipment Directory
9. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 – Fire Code of New York State
10. Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (FCCCHR) Publication:
    a. List of Approved Backflow Prevention Assemblies (Obtain current date from NAVFAC HQ, Code 04)

1.03 QUALIFICATIONS OF INSTALLER

A. Prior to installation, submit data for approval showing that the Contractor has successfully installed automatic fire extinguishing sprinkler systems of the same type and design as specified herein, or that Contractor has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. The Contractor shall indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. System layout and installation shall be under the direct supervision of a NICET Level 3 or Level 4 certified technician.

1.04 DESCRIPTION OF WORK

A. The work includes designing and modifying existing light hazard automatic wet pipe fire extinguishing sprinkler systems for uniform distribution of water by hydraulic design to afford complete fire protection coverage to protect spaces as indicated on Contract Drawings. The design, equipment, materials, installation, workmanship, examination, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 13, except as modified herein. Each system shall include all materials, accessories, and equipment inside the building to provide each system complete and ready for use. Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ductwork, and other construction and equipment in accordance with detailed drawings to be submitted for approval. Locate sprinkler heads in a consistent pattern with ceiling grid, lights, and supply and return air diffusers and

grilles. Devices and equipment for fire protection service shall be UL FPED listed or FM P7825 approved for use in wet pipe sprinkler systems. In the NFPA publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; reference to the "authority having jurisdiction" shall be interpreted to mean the Engineer Division, Naval Facilities Engineering Command, Fire Protection Engineer. The work shall begin at the points indicated.

1.05 SUBMITTALS

A. Manufacturer's Data:
   1. Pipe, fittings, and mechanical couplings
   2. Sprinkler heads
   3. Pipe hangers and supports

B. Shop Drawings:
   1. Submittals shall be prepared by a NICET Level 3 or Level 4 fire sprinkler layout technician. Submittals shall bear the technician's NICET certification number.
   2. Sprinkler heads and piping system layout
   3. System hydraulic calculations for each remote area in accordance with NFPA 13

C. Fabrication/Erection/Installation Drawings:
   1. Partial submittals will not be acceptable. Annotate descriptive data to show the specific model, type, and size of each item the Contractor proposes to provide. Prepare working drawings on sheets not smaller than 30 inches by 42 inches, in accordance with the requirements for "Working Drawings (Plans)" as specified in NFPA 13; include data for proper installation of each system. The Engineer, will review and approve submittals. Before any work is commenced, submit the design, manufacturer's data, system hydraulic calculations, and complete sets of working drawings for each system.

D. Certificate of compliance:
   1. Contractor's material and test certificate
   2. Pipe and fittings

E. Operation and Maintenance Manuals:
   1. Sprinkler System and hydraulic calculations
   2. After completion, but before final acceptance of the work, furnish a complete set of drawings of each system for record purposes. Drawings shall not be smaller than 30 inches by 42 inches drawings on Mylar film with title block (8 inches by 4 inches) similar to full size Contract

Drawings. Furnish the as built (record) working drawings in addition to the as built Contract Drawings required by Division 1, "General Requirements".

1.06 ELECTRICAL WORK

A. Provide electrical work associated with this section under Division 26, except for control and fire alarm wiring. Provide control and fire alarm wiring, including connections to fire alarm systems, under this section in accordance with NFPA 70 and Division 26. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Design of Sprinkler Systems: NFPA 13 and requirements specified herein. Design of automatic wet pipe fire extinguishing sprinkler systems shall be by hydraulic calculations for uniform distribution of water over the design area for light hazard occupancy.

B. Water Distribution: Distribution shall be uniform throughout the area in which it is assumed the sprinkler heads will open. Variation in discharge from individual heads in the hydraulically most remote area shall be between 100 and 120 percent of the specified density.

C. Density of Application of Water: Size pipe to provide the specified density when the system is discharging the specified total maximum required flow. Application to horizontal surfaces below the sprinklers shall be 0.10 gpm per square foot.

D. Sprinkler Discharge Area: Area shall be the hydraulically most remote 1,500 square feet area as defined in NFPA 13.

E. Outside Hose Allowances: Hydraulic calculations shall include an allowance of 100 gpm for outside hose streams.

F. Friction Losses: Calculate losses in piping in accordance with the Hazen Williams formula with "C" value of 120 for steel piping, 150 for copper tubing, and 140 for cement lined ductile iron piping and asbestos cement piping.

G. Location of Sprinkler Heads: Heads in relation to the ceiling and the spacing of sprinkler heads shall not exceed that permitted by NFPA 13 for light hazard occupancy. Uniformly space sprinklers on the branch piping.

H. Water Supply Flow Test: Perform NFPA 291 flow test to confirm water supply prior to submission of installation drawings and hydraulic calculations. Base hydraulic calculations on the static pressure of the existing water supply in conjunction with the maximum flow rate available and the residual pressure at the maximum available flow rate.

I. Sprinkler Heads: Heads shall have nominal 0.50 inch orifice. Release element of each head shall be of the ordinary temperature rating or higher as suitable for the specific application. Provide polished stainless steel ceiling plates or chromium plated finish on copper alloy ceiling plates, and chromium plated pendent sprinklers below suspended ceilings. Provide corrosion resistant sprinkler heads and sprinkler head guards as required by NFPA 13. Finish of sprinkler units in suspended ceilings shall be white unless otherwise directed. Provide institutional quick response, flush pendent sprinkler of tamper-resistant construction, consisting of sprinkler body, lock ring and 3-1/4" diameter thread-on escutcheon plate in the security area as shown on the Contract Drawings.

J. Cabinet: Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. The number and types of extra sprinkler heads shall be as specified in NFPA 13.

K. Aboveground Piping Systems: Inspect, test, and approve piping before covering or concealing. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Perform welding in the shop; field welding will not be permitted. Conceal piping in areas with suspended ceiling.
   1. Sprinkler Pipe and Fittings: Provide in accordance with NFPA 13. Steel piping shall be Schedule 40 for sizes 2 inches and smaller, with ASME B.1.20.1 threaded ends. Steel pipe diameters 2-1/2" and larger shall be Schedule 10, roll grooves. Fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved end type. Plain end fittings with mechanical couplings and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Rubber gasketed grooved end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 2-1/2 inches and larger. Fittings shall be UL FPED listed or FM P7825 approved for use in wet pipe sprinkler systems. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer.
   2. Pipe Hangers and Supports: Provide in accordance with NFPA 13.

L. Pipe Sleeves: Provide where piping passes through walls, floors, roofs, and partitions. Grout sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide clearance between exterior of piping and interior of sleeve in accordance with NFPA 13. Firmly pack space with noncombustible insulation. Caulk both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal.

1. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: Provide ASTM A53 or ASTM A120, hot dip galvanized steel pipe sleeves. Extend sleeves 3 inches above the finished floor.
2. Sleeves in Partitions, Non Masonry Walls, Floors, and Roofs: Provide hot dip galvanized steel sheet having a nominal weight of not less than 0.90 psf.

M. Escutcheon Plates: Provide one piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces. Secure plates in proper position.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment, materials, installation, workmanship, examination, inspection, and testing shall be in accordance with NFPA 13, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Keep the interior and ends of new piping and existing piping affected by Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position. Center sprinklers in two directions in ceiling tile.

3.02 FIELD PAINTING

A. Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat of DOD P 15328 pretreatment primer applied to a minimum dry film thickness of 0.3 mil, and one coat of FS TT P 645 primer applied to a minimum dry film thickness of 1.0 mil. Shield sprinkler heads with protective covering while painting is in process. Upon completion of painting, remove protective covering from sprinkler heads.

Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

1. Systems in Unfinished Areas: Unfinished areas are defined as attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, and spaces where walls or ceiling are not painted or not constructed of a pre-finished material. Provide primed surfaces with one coat of FS TT E 489 red enamel applied to a minimum dry film thickness of 1.0 mil. In lieu of field painting, Contractor may provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals.
2. Systems in Other Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of FS TT E 489 red enamel applied to a minimum dry film thickness of 1.0 mil. Provide piping with 2 inch wide red enamel bands or self-adhering red plastic bands spaced at maximum of 20 foot intervals. In finished areas such as offices, the red bands may be omitted.

3.03 TESTING AND FLUSHING

A. Preliminary Tests: Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in gauge pressure. Flush piping with potable water in accordance with NFPA 13. Piping above suspended ceilings shall be inspected, tested, and approved before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. When tests are completed and corrections made, submit a signed and dated certificate, similar to that specified in NFPA 13, with a request for formal inspection and tests.

B. Formal Inspection and Tests: The Contractor shall notify Engineer and Owner at least 15 days prior to commencement of testing. An experienced technician regularly employed by the system installer shall be present during the testing and inspection. Correct defects in work provided by the Contractor, and make additional tests until the systems comply with all contract requirements. Furnish appliances, equipment, water, electricity, instruments, connecting devices, and personnel for the tests.

END OF SECTION

SECTION 22 00 00

PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Plumbing General Requirements, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Division 1, “General Requirements”
2. Division 22, “Plumbing”
3. Division 23, “Mechanical”
4. Division 26, “Electrical”
5. Division 31, “Earthwork”
6. Division 33, “Utilities”

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
1. Code of Federal Regulations (CFR) Publications:
a. 29-1910 SUBPART O – Machinery and Machine Guarding
b. 29-1910.219 – Mechanical Power Transmission Apparatus

1.03 SUBMITTALS

A. Submit shop drawings, manufacturer's data, publication compliance, certified test reports, and manufacturer's certificates of compliance for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication or delivery of the items to the job site. Shop drawings shall be accompanied by a letter of transmittal in duplicate, and all shop drawings shall be suitably identified with the name of the project, contract number, Contractor's name, date and initials indicating approval of such submittal by the Contractor under the applicable specification. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and the specific technical paragraph reference which specifies each item, applicable industry and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished.
1. Manufacturer's Data: Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

2. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
3. Manufacturer's Certificates of Compliance: Submit certification from manufacturer attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certifications will not be acceptable; certifications shall be the manufacturer's original; certifications shall be not more than one year old. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified. Certificates shall be signed by the manufacturer's official authorized to sign certificates of compliance.
4. Reference Standards Compliance: Where equipment or materials are specified to conform to industry and technical society reference standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted. If an organization uses a label or listing to indicate compliance with a particular reference standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections.
    a. Independent Testing Organization Certificate: In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.04 OPERATION AND MAINTENANCE MANUAL

A. Furnish an operation and maintenance manual for each item of equipment. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual to the Owner's Representative for review and approval not more than 90 calendar days after an item is approved, but at least 60 calendar days prior to field acceptance testing of the item. Furnish the remaining manuals at least 60 days prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL", the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start up, operation and shut down; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shut down instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

1.05 CATALOGED PRODUCTS

A. Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.06 MANUFACTURER'S RECOMMENDATIONS

A. Unless otherwise stated in the Contract Specifications, all new equipment items, and specialties shall be installed in strict accordance with the recommendations of the manufacturer of the items being installed. Prior to the installation of new items, the Contractor shall submit to the Owner's representative printed copies of the manufacturer's installation recommendations. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material. Failure to install items in accordance with manufacturer's recommendations can be cause for rejection of the work items installed.

1.07 LAYOUT OF THE WORK

A. Coordinate the proper relation of the work to the building structure, existing utilities and to the work of all trades. Visit the premises and become familiar with the dimensions in the field, and advise the Owner's Representative of any discrepancy before performing any work.

1. Contract Drawings: The Contract Drawings represent the general intent as to piping and equipment arrangements. All locations and dimensions shown shall be field verified and minor alterations made if so required. Where dimensions are not given for the location and arrangement of mechanical systems, locations may be assumed to be approximate, and may be altered if required. Major modifications to the indicated arrangements shall be approved by the Owner's Representative prior to the installation of mechanical systems. Schematic diagrams represent the overall system requirements and do not necessarily indicate the physical orientation, location or dimensions of that system.
2. Record Drawings: The Contractor shall maintain a record of the progress of the work and shall submit three (3) sets of As-Built Drawings upon completion of the project.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Properly store, adequately protect, and carefully handle equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Engineer. Replace damaged or defective items.

1.09 SAFETY REQUIREMENTS

A. Equipment Safety: Fully enclose or properly guard in accordance with 29 CFR 1910.219 belts, pulleys, chains, gears, couplings, projecting setscrews, keys, rotating parts, and other power transmission apparatus, located where persons can come in close proximity thereto. Points of operation, ingoing nip points, and machinery producing flying chips and sparks shall be guarded in accordance with the applicable portions of 29 CFR 1910 SUBPART O. Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified. Provide catwalks, maintenance platforms, and guardrails where required for safe operation and maintenance of equipment. Provide ladders or stairways to reach catwalks and maintenance platforms. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters and tools.

1.10 ELECTRICAL REQUIREMENTS

A. Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Division 26-Electrical. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under this Section. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Division 26 – Electrical. Unless specifically noted otherwise, all control wiring (120 volt or less) shall be provided by Mechanical Contractor and conform to the requirements of Division 26 – Electrical.

1.11 INSTRUCTION TO OWNER'S PERSONNEL

A. When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Owner's personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 days of instruction are specified, use approximately half of the time for classroom

instruction. Use other time for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the Contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.12 INSPECTIONS AND CERTIFICATIONS

A. The Contractor shall provide and pay for any third party inspections or certifications required by applicable regulatory agencies for boilers and other mechanical equipment components modified, or furnished and installed as a part of the Contract work.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for identification of plumbing piping and equipment including all pumps, hot water heaters, storage tanks, piping and valves using color bands, lettering, flow direction arrows, and related permanent identification devices for Identification for Plumbing Piping and Equipment, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
   1. Section 22 00 00 – Plumbing General Requirements
   2. Section 22 07 00 – Plumbing Insulation

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
   1. American National Standards Institute, Inc. (ANSI) Publication:
      a. A13.1 – Scheme for the Identification of Piping Systems
      b. Z535.1 – Safety Color Code

1.03 SUBMITTALS

A. Manufacturer's Data:
   1. Label, Tag and Nameplate materials
   2. List of wording, symbols, letter size, and color coding to be used
   3. Valve chart
   4. Accessory materials

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pipe labels, valve tags and equipment nameplates shall be as manufactured by Marking Services Incorporated, or approved equal.
   1. Nameplates: Three-ply laminated phenolic plastic at least 1/16" thick with black surfaces and white core. Engraving shall be minimum ½" high with appropriate spacing. Text shall be white on black background. Nomenclature shall match the equipment designation as indicated on the Plans and Schedules.

2. Valve Tags: Three-ply laminated phenolic plastic at least 1/16" thick with black surfaces and white core. Engraving shall be minimum ½" high with appropriate spacing. Text shall be white on black background. Valve tag shall be minimum 1-1/2" diameter with smooth edges.
3. Pipe Markers: Color, text and size shall conform to ASME/ANSI Standard A13.1.
    a. Plastic Pipe Markers: Strap-type labels shall be factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering with flow direction arrows and identification of fluid being conveyed. Straps shall be self-locking nylon ties.
    b. Plastic Tape Pipe Markers: Self-adhesive flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings with flow direction arrows and identification of fluid being conveyed.
4. Valve Chart: Valve chart(s) shall be printed on 8-1/2"x11" white paper with typewritten black text, minimum 12 point character size. Information to be provided shall be, at a minimum, the number, location, size and function of each line valve installed under this Contract. Chart shall be installed in a glazed frame and permanently mounted to wall in mechanical room or other suitable location coordinated with the Owner.

PART 3 - EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 GENERAL

A. All markers shall be installed in accordance with manufacturer's printed instructions, and shall be neat and uniform in appearance. All tags or markers shall be oriented such that they are readily visible from all normal working locations. All equipment above lift-out ceilings or made accessible by access doors shall be labeled in the same manner as that of exposed equipment.

3.03 NAMEPLATES

A. Install plastic nameplates with corrosive resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. Equipment to be labeled shall include but not be limited to the following items: pumps, hot water heaters, storage tanks, water treatment equipment, air compressors, plumbing control devices, switches, control panels and other related devices.

3.04 VALVE TAGS

A. Install valve tags on all valves except simple service and drain valves located within 10 feet and sight distance of the device or equipment served. For example, it would not be expected that strainer blow-down values in a machine room would be tagged. Each tag shall be attached to its valve with copper clad annealed iron wire, corrosion resistant chain, or other approved material.

3.05 PIPE MARKERS

A. Exposed piping shall be identified at intervals of 20 feet and at least one time in each room. Provide a pipe marker at each valve. Provide arrow markers at each pipe marker with arrows pointing away from the pipe marker to indicate direction of flow. When flow can be in either or both directions, provide a double ended arrow marker. Provide pipe and arrow marker at every point of pipe entry or exit where line penetrates a wall or service chase. Self-adhesive labels shall be used to identify piping under 6 inches in diameter when insulated and covered. For finished pipe sizes 6 inches and larger, strap type markers with self-locking nylon ties shall be utilized.

3.06 MISCELLANEOUS EQUIPMENT

A. Small items such as inline pumps shall be identified with tags in lieu of nameplates. Submit labeling plan to Engineer for devices and equipment not otherwise specified herein.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Plumbing Insulation as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Section 22 00 00 – Plumbing General Requirements
2. Section 22 11 16 – Domestic Water Piping
3. Section 22 34 36 – Commercial Gas Domestic Water Heaters
4. Section 22 42 00 – Commercial Plumbing Fixtures

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
1. American Society for Testing and Materials (ASTM) Publication:
a. A167 – Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip
b. C177 – Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus, Test Method
c. C195 – Mineral Fiber Thermal Insulating Cement
d. C534 – Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
e. C547 – Mineral Fiber Preformed Pipe Insulation
f. C552 – Cellular Glass Block and Pipe Thermal Insulation
g. C553 – Mineral Fiber Blanket and Felt Insulation (Industrial Type)
h. C612 – Mineral Fiber Block and Board Thermal Insulation
i. C795 – Wicking Type Thermal Insulation for Use Over Austenitic Stainless Steel
j. C921 – Properties of Jacketing Materials for Thermal Insulation
k. D227 – Coal Tar Saturated Organic Felt Used in Roofing and Waterproofing
l. E84 – Surface Burning Characteristics of Building Materials
m. E96 – Water Vapor Transmission of Materials
2. Manufacturer’s Standardization Society of the Valves and Fittings Industry (MSS) Publication:
a. SP 58 – Pipe Hangers and Supports Materials, Design, and Manufacture
b. SP 69 – Pipe Hangers and Supports Selection and Application
3. National Fire Protection Association (NFPA) Publication:
a. 255 – Surface Burning Characteristics of Building Materials

4. Underwriters Laboratories, Inc. (UL) Publication:
    a. 723 – Tests for Surface Burning Characteristics of Building Materials
5. Uniform Fire Prevention and Building Code of New York State Publication:
    a. 2020 – Plumbing Code of New York State
    b. 2020 – Energy Conservation Construction Code of New York State

1.03 SUBMITTALS

A. Manufacturer's Data:
    1. Insulation
    2. Jackets
    3. Vapor-barrier materials
    4. Accessory materials

B. Standards Compliance: Standards compliance labels are requirements on each container or package
    1. Insulation
    2. Jackets
    3. Vapor-barrier materials
    4. Accessory materials

1.04 DEFINITIONS

A. Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.

B. Unfinished Spaces: Spaces used for storage or work areas where appearance is not a factor, such as unexcavated spaces and crawl space.

C. Concealed Spaces: Spaces out of sight. For example, above ceilings; below floors; between double walls; furred in areas; pipe and duct shafts; and similar spaces.

D. Exposed: Open to view. For example, pipe running through a room and not covered by other construction.

E. Fugitive Treatments: Treatments subject to deterioration due to aging, moisture, high humidity, oxygen, ozone, and heat. Fugitive materials are entrapped materials that can cause deterioration, such as solvents and water vapor.

F. Outside: Open to view up to 5 feet beyond the exterior side of walls, above the roof, and unexcavated or crawl spaces.

1.05 MANUFACTURER'S STAMP OR LABEL

A. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be asbestos free.

1.06 FLAME SPREAD AND SMOKE DEVELOPED RATINGS

A. In accordance with NFPA 255, ASTM E84 or UL 723, the materials shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50.
   1. Materials Tests: Test factory applied materials as assembled. Field applied materials may be tested individually. Use no fugitive or corrosive treatments to impart flame resistance. UL label or satisfactory certified test report from a testing laboratory will be required to indicate that fire hazard ratings for materials proposed for use do not exceed those specified. Flame proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
   2. Materials Exempt From Fire Resistant Rating: Nylon anchors.

B. Materials Exempt from Fire Resistant Rating When Installed In Outside Locations, Buried, or Encased In Concrete: PVC casing and glass fiber reinforced plastic casing.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS INSULATION

A. Piping systems (except buried pipe) requiring insulation, types of insulation required, and insulation thickness shall be as listed in Tables I and II herein. Except for flexible unicellular insulation, insulation thicknesses as specified in Table II shall be one inch greater for insulated piping systems located outside. Unless otherwise specified, insulate all fittings, flanges, and valves, except valve stems, hand wheels, and operators. Use factory premolded, precut, or field fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling. Pipe insulation shall conform to the referenced publications in Table I.
   1. Flexible Unicellular Insulation: ASTM C534. The minimum density limit of 4.5 pounds per cubic foot may be waived if all other characteristics of the standard are met.
   2. Piping Insulation Finishes:
      a. All Purpose Jacket: Except calcium silicate and unicellular insulation, provide a factory applied all-purpose jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field

painting. Allow a maximum water vapor permeance of 0.05 perm per ASTM E96, a puncture resistance of not less than 50 Beach units, and a minimum tensile strength of 35 pounds force per inch of width.

b. Vapor Barrier Material: Resistant to flame, moisture penetration, and mold growth. Provide vapor barrier material on pipe insulation as required in Table I.

2.02 ADHESIVES, SEALANTS, AND COATING COMPOUNDS

A. Adhesive for Securing Insulation to Metal Surfaces and Vapor Barrier Lap Adhesive (For Use in Building Interior Only): ASTM C916, Type I (an adhesive in which the vehicle is nonflammable in liquid (wet) state and which will pass the edge burning test), or Type II (An adhesive in which the vehicle is nonflammable in the liquid (wet) state and which will not pass the edge burning test).

B. Mineral Fiber Insulation Cement: ASTM C195, thermal conductivity 0.85 maximum at 200 degrees F mean when tested per ASTM C177.

C. Weatherproof Coating: For outside applications use a weatherproof coating recommended by the manufacturer of the insulation and jackets.

2.03 ACCESSORIES

A. Staples: ASTM A167, Type 304stainless steel outside clinch type.

B. Insulation Bands: 3/4 inch wide0.20 inch aluminum.

C. Bands for Metal Jackets: 3/8 inch minimum width; 0.01 inch stainless steel or 0.020 inch aluminum

D. Anchor Pins: Provide anchor pins and speed washers recommended by the insulation manufacturer.

E. Glass Cloth and Tape: Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be used.

F. Coal Tar Saturated Organic Felt: ASTM D227, minimum weight of 13 pounds per 100 square feet.

G. Wire: Soft annealed stainless steel, 0.047 inch nominal diameter.

PART 3 - EXECUTION

3.01 PREPARATION

A. Do not insulate materials until all system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handle, safety relief, etc. Allow adequate space for pipe expansion. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings. Extend all surface finishes to protect all surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
   1. Vertical portion of interior roof drain pipelines, chrome plated pipes, and fire protection pipes.
   2. Vibration isolating connections.
   3. Adjacent insulation.
   4. ASME stamps.

3.02 PIPING INSULATION

A. Pipe Insulation (Except Unicellular Insulation): Installation of plumbing insulation including materials and workmanship shall be in accordance with the Energy Conservation Construction Code of New York State, except as modified herein. Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive, factory applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on centers and l/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps. Apply staples to both edges of the butt strips. When a vapor barrier jacket is required, as indicated in TABLE I, or on the ends of sections of insulation that butt against flanges, unions, valves, and fittings, and joints, use a vapor barrier coating or manufacturer's weatherproof coating for outside service. Apply this vapor barrier coating at all longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend the patch not less than l-l/2 inches past the break in both directions. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating. Do not use staples to secure jacket laps on pipes carrying fluid

medium at temperatures below 35 degrees F. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior insulation to the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches down beyond the end of the insulation. Seal the flashing and counterflashing underneath with the vapor barrier coating. In cold water piping in high humidity areas, use cellular glass, or flexible unicellular insulation.

B. Flexible Unicellular Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90 degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral fiber insulation inserts and sheet metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of vinyl lacquer finish to flexible unicellular insulation in outside locations.

C. Hangers and Anchors: Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide MSS SP 58, Type 40 galvanized steel shields or MSS SP 58, Type 39 protection saddles conforming to MSS SP 69. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of cellular glass (minimum 8 pcf), molded glass fiber (minimum 8 pcf), or other approved material of the same thickness as adjacent insulation. Inserts shall have sufficient compressive strength to adequately support the pipe without compressing the inserts to a thickness less than the adjacent insulation. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with vapor barrier coating, or for exterior work, manufacturers recommended weatherproof coating, as applicable. Where protection saddles are used, fill all voids with the same insulation material as used on the adjacent pipe.

D. Sleeves and Wall Chases: Where penetrating interior walls, extend a metal jacket 2 inches out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches beyond the interior surface of the wall.

E. Flanges, Unions, Valves and Fittings Insulation (Except Flexible Unicellular) for Hot Piping: Factory fabricated removable and reusable insulation covers may be used. For inside domestic hot water and exposed hot water piping and drains in handicap areas, place factory premolded, precut or field fabricated segmented insulation of the same thickness and conductivity as the adjoining pipe insulation around the flange, union, valve, and fitting abutting the adjoining pipe insulation. If nesting size insulation is used, overlap 2 inches or one pipe diameter whichever is larger. Use insulating cement to fill voids. Elbows insulated using segments

shall have not less than three segments per elbow. Place and joint the segments with manufacturer's recommended water vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Upon completion of installation of insulation, apply two coats of lagging adhesive with glass tape embedded between coats. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. The total dry film thickness shall be not less than 1/16 inch. Where unions are indicated not to be insulated, taper the insulation to the union at a 45 degree angle. Coat the insulation and all-purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. The total dry film thickness shall be not less than 1/16 inch. At the option of the Contractor, factory premolded one piece PVC fitting covers may be used in lieu of two coats of adhesive with tape embedded between coats. Factory premolded field fabricated segment or blanket insert insulation shall be used under the fitting covers. Install factory premolded one piece PVC fitting covers over the insulation and secure by stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not use PVC fitting covers where exposed to the weather. Limit the use of PVC fitting covers to ambient temperatures below 150 degrees F.

F. Flanges, Unions, Valves, Anchors, Fittings for Cold Piping: Factory fabricated removable and reusable insulation covers may be used. For piping insulation inside the building that service domestic cold water above ceilings, drinking fountain drain piping to sewer tie in, and horizontal roof drain leaders, coat pipe insulation ends with vapor barrier coating not more than six inches from each flange, union, valve, anchor or fitting. Place insulation of the same thickness and conductivity as the adjoining pipe insulation (either premolded or segmented) around the item, butting the adjoining pipe insulation. If nesting size insulation is used, overlap the insulation 2 inches or one pipe diameter. Use loose fill mineral wool or insulating cement to fill the voids. Elbows insulated using segments shall not have less than 3 segments per elbow. Insulation may be secured by wire or tape until finish coating is applied. Apply two coats of vapor barrier coating with glass tape embedded between coats. Overlap tape seams one inch. Extend the coating out onto the adjoining pipe insulation 2 inches. Where unions are shown not to be insulated, the insulation shall be tapered to the union at a 45 degree angle. Seal the insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to the pipe for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface. Insulate flexible connections at pumps and other equipment with unicellular plastic insulation, unless otherwise indicated. At the option of the Contractor, premolded, one piece polyvinyl chloride (PVC) fitting covers may be used in lieu of the embedded glass tape. Factory premolded insulation or field fabricated insulation segments shall be used under the fitting covers. Blanket inserts may be used. Secure the covers with adhesive and vapor barrier tape with a vapor resistance of maximum 0.05 perm per ASTM E96, or

with tacks made for securing PVC covers. Then coat all tape seams and tacks with Type II vapor barrier coating. Do not use premolded PVC fitting covers where exposed to weather. Limit the use of PVC covers to not less than 35 degrees F medium temperatures and below 150 degrees F ambient temperatures.

3.03 PAINTING AND IDENTIFICATION

A. Paint in accordance with Section 09 91 00, "Painting". Piping identification shall be as specified in Section 22 05 53, “Identification for Plumbing Piping and Equipment”.

3.04 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

TABLE I
INSULATION MATERIAL FOR PIPING

SERVICE	MATERIAL	SPEC.	TYPE	CLASS	VAPOR BARRIER REQUIRED
*Domestic Hot Water and Hot Water Recirculating Piping	Mineral Fiber	ASTM C547		1	No
	Cellular Glass	ASTM C552	II	2	No
	Flexible Unicellular	ASTM C534	I or II		No
Domestic Cold Water Piping Above Ceilings	Mineral Fiber	ASTM C547		1	Yes
	Cellular Glass	ASTM C552	II	2	No
	Flexible Unicellular	ASTM C534	I or II		No
Drinking Fountain, Drain Piping (to sewer tie in)	Mineral Fiber	ASTM C547		1	Yes
	Cellular Glass	ASTM C552	II	2	No
	Flexible Unicellular	ASTM C534	I or II		No
Horizontal Roof Drain Leaders	Mineral Fiber	ASTM C553	I	B-3	Yes
Exposed Domestic Water and Drains Areas (Handicap Personnel)	Flexible Unicellular	ASTM C534	I or II		No

*NOTE: If there is no condensation condition existing, insulation is not required for CPVC or PVC piping.

TABLE II PIPING INSULATION WALL THICKNESS						
SERVICE	**MATERIAL**	**TUBE AND PIPE SIZE (INCHES)**				
		1/4 - 3/4	**1 – 1-1/4**	**1-1/2 - 3**	**4 - 6**	**8+**
Domestic Water (Hot and Recirculating), and Insulated Drains	Mineral Fiber	1	1	1-1/2	1-1/2	1-1/2
	Cellular Glass	1	1	1-1/2	1-1/2	1-1/2
	Flexible Unicellular	1	1	1-1/2	1-1/2	1-1/2
Horizontal Roof Drain Leaders (Including underside of roof drain fittings)	Mineral Fiber	1/2	1/2	1	1	1

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Domestic Water Piping, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
   1. Section 22 00 00 – Plumbing General Requirements
   2. Section 22 34 36 – Commercial Gas Domestic Water Heaters
   3. Section 22 42 00 – Commercial Plumbing Fixtures

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
   1. American National Standards Institute (ANSI) Publication:
      a. A112.26.1M - Water Hammer Arrester
      b. B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings
      c. B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
      d. B16.23 – Cast Copper Alloy Solder Joint Drainage Fittings –DWV
      e. B16.24 – Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300
      f. B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes
      g. B16.39 – Malleable Iron Threaded Pipe Unions, Class 150, 250 and 300
   2. American Society of Mechanical Engineers (ASME) Publication:
      a. B40.100 – Pressure Gauges and Attachments
      b. B40.200 – Thermometers, Dial Reading and Remote Reading
   3. American Society for Testing and Materials (ASTM) Publication:
      a. A48 – Gray Iron Castings
      b. A126 – Gray Iron Castings for Valves, Flanges, and Pipe Fittings
      c. B32 – Solder Metal
      d. B61 – Steam or Valve Bronze Castings
      e. B62 – Composition Bronze or Ounce Metal Castings
      f. B88 – Seamless Copper Water Tube
      g. D2846 – Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot and Cold Water Distribution Systems
      h. F439 – Socket Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
      i. F441 – Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

j. F493 – Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

4. American Society of sanitary Engineering (ASSE) Publication:
   a. 1003 – Water Pressure Reducing Valves for Domestic Water Supply Systems
   b. 1010 – Water Hammer Arresters
   c. 1019 – Wall Hydrants, Frost Proof Automatic Draining, Anti backflow Types
5. American Water Works Association (AWWA) Publication:
   a. C104 – Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fitting for Water
   b. C105 – Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
   c. C110 – Gray Iron and Ductile Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids
   d. C111 – Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
   e. C115 – Flanged Ductile Iron and Gray Iron Pipe with Threaded Flanges
   f. C500 – Gate Valves, 3 Through 48 inch NPS, for Water and Sewage Systems
   g. C504 – Rubber Seated Butterfly Valves
   h. C651 – Disinfecting Water Mains
   i. C700 – Cold Water Meters, Displacement Type
   j. C701 – Cold Water Meters, Turbine Type for Customer Service
   k. C702 – Cold Water Meters, Compound Type
6. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publication:
   a. SP 58 – Pipe Hangers and Supports Materials, Design and Manufacture
   b. SP 67 – Butterfly Valves
   c. SP 69 – Pipe Hangers and Supports Selection and Application
   d. SP 70 – Cast Iron Gate Valves, Flanged and Threaded Ends
   e. SP 80 – Bronze Gate, Globe, Angle and Check Valves
   f. SP 85 – Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
7. Plumbing and Drainage Institute (PDI) Publication:
   a. WH201 – Water Hammer Arresters
8. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 – Plumbing Code of New York State
9. Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (FCCCHR) Publication:
   a. List of Approved Backflow Prevention Assemblies (Obtain current date from NAVFAC HQ, Code 04)

1.03 GENERAL REQUIREMENTS

A. Section 22 00 00, "Plumbing General Requirements", applies to this Section, with the additions and modifications specified herein. Plumbing systems including equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code of New York State, except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears. Capacity of equipment shall be not less than that indicated. Plumbing systems shall include all water piping buried and aboveground to a limit of 5 feet outside of the building walls unless otherwise specified, or indicated by the Contract Drawings.

1.04 SUBMITTALS

A. Manufacturer's Data:
   1. Pipe and fittings
   2. Valves and Valve Boxes
   3. Pipe supports (hangers)
   4. Gauges and thermometers
   5. Water meters
   6. Strainers
   7. Water hammer arresters
   8. Backflow preventers

B. Shop Drawings:

C. Certificates of Conformance
   1. Pipe and fittings
   2. Valves
   3. Backflow preventers

PART 2 - PRODUCTS

2.01 DOMESTIC WATER PIPING

A. Buried Piping and Aboveground Piping:
   1. Copper Tubing: ASTM B88, Type K, with ANSI B16.26 flared joint fittings for all below ground piping. ASTM B88, Type L, with ANSI B16.18 or ANSI B16.22 solder joint fittings using ASTM B32, 95-5 tin-antimony or grade Sn96 tin-silver solder, and flux containing not more than 0.2% lead, shall be provided for aboveground piping.

2. Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Fittings, and Solvent Cement:
   a. Piping Sizes 0.75 Inch and 0.50 Inch: ASTM D2846.
   b. Piping Sizes One Inch through 2 Inches: ASTM F441, Schedule 80 pipe; ASTM F439, Schedule 80 fittings; and ASTM F493 solvent cement.
3. Cast Ductile Iron Piping: Sizes 4 inches and larger, outside coated, AWWA C104 cement mortar lined, AWWA C151 ductile iron pipe, AWWA C111 rubber gasket joints, and AWWA C110 fittings. Provide concrete thrust blocks at the elbow where the buried piping turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Aboveground piping shall have flanged end connections conforming to AWWA C115 for flanged pipe and AWWA C110 for flanged fittings.

B. Water Valves: Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have flanged end connections, except sizes smaller than 2.5 inches may have threaded end connections with a union on all but one side of the valve, or solder end connections between bronze valves and copper tubing. Copper alloy and bronze valve body shall be ASTM B61 or ASTM B62 copper alloy. Ball valves may be provided in lieu of gate valves.
   1. Gate Valves 2-1/2” and Larger: Class 125 iron body, bronze mounted, ASTM A126 Class B cast iron body and bonnet, flanged ends, Teflon-impregnated packing and two-piece packing gland. Manufacture shall be as by Stockham, Crane, Powell, or equal.
   2. Gate Valves 2” and Smaller: Class 125, ASTM B62 cast bronze composition body and bonnet, soldered ends, solid disc, copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing and malleable hand wheel. Manufacture shall be as by Stockham, Crane, or equal.
   3. Ball Valves 2” and Smaller: 600 psi cwp, cast brass bodies, two-position hand levers, replaceable reinforced Teflon seats, conventional port, blow-out proof stems, chrome-plated brass ball, soldered ends with extended solder cups. Manufacture shall be as by Stockham, Crane, Apollo, or equal.
   4. Globe Valves 2-1/2” and Larger: Class 125 iron body, bronze mounted with ASTM A-126 Class B cast iron body and bonnet, flanged ends, Teflon-impregnated packing and two-piece packing gland assembly. Manufacture shall be as by Stockham, Crane, Powell, or equal.
   5. Globe Valves 2” and Smaller: Class 125, ASTM B62 cast bronze composition body and bonnet, soldered ends, copper silicon alloy stem, brass packing gland, Teflon-impregnated packing and malleable hand wheel. Manufacture shall be as by Stockham, Crane, Powell, or equal.

6. Butterfly Valves 2-1/2" and Larger: Wafer type, 200 psi cwp, ASTM A126 Class B cast iron body, replaceable EPDM sleeve, ductile nickel-plated disc, 410 stainless steel stem and EPDM O-ring stem seals. 2-1/2"-6" sizes – lever operated; 8"-24" – gear operated. Manufacture shall be as by Stockham, Crane, or equal.
7. Check Valves 2-1/2" and Larger: Iron body, bronze mounted, ASTM A126 Class B cast iron body and cap, flanged ends and swing disc type. Manufacture shall be as by Stockham, Crane, Powell, or equal.
8. Check Valves 2" and Smaller: Class 125, soldered ends, ASTM B62 cast bronze composition bodies and caps and swing disc type. Manufacture shall be as by Stockham, Crane, Powell, or equal.
9. Hose Bibbs: Provide angle type copper alloy hose bibb with lockshield and hand wheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75 inch external hose threads.
10. Nonfreeze Wall Hydrant: ASSE 1019, cast bronze, with lockshield and hand wheel, one inch external thread inlet, 0.75 inch external hose thread outlet with automatic draining vacuum breaker. Hydrant shall be of sufficient length to extend through walls and place the valve seat inside the building or in the crawl space. Bonnet and valve stem shall be removable from outside of the building.
11. Water Pressure Reducing Valves: ASSE 1003.

C. Strainers: Class 125, Style Y, cast bronze body, 20 mesh stainless steel screen and shall have blow-off outlet with pipe nipple and gate valve. Manufacture shall be as by Watts, Sarco, or equal.

D. Gauges: ASME B40.100, single style pressure gauge for water with 4 inch dial, brass or aluminum case, bronze tube, gauge cock, pressure snubber, and syphon. Provide scale range suitable for the intended service.

E. Thermometers: ASME 40.200, bi metal dial type thermometers with stainless steel case, stem, and fixed thread connection; 5 inch diameter dial with glass face gasketed within the case; accuracy within 1.0 percent of scale range. Provide scale range suitable for the intended service.

F. Dielectric Connections: Provide at connections between copper and ferrous metal piping materials. ASTM F441, Schedule 80, CPVC threaded pipe nipples, 4 inch minimum length, may be provided for dielectric connections in pipe sizes 2 inches and smaller.

G. Water Hammer Arresters: PDI WH201, ANSI A112.26M.1, or ASSE 1010, elastomer bellows or plunger type with stainless steel or copper shell. Manufacture shall be as by Josam, Zurn, Watts, or equal.

H. Valve Boxes: For each buried valve provide ASTM A48 cast iron or ductile iron of a suitable size. Provide cast iron or ductile iron cover for the box with the word "WATER" cast on the cover. Coat cast iron and ductile iron boxes with bituminous paint.

I. Backflow Preventers: Reduced pressure principle (RPZ) type. Proof shall be furnished that each make, model/design, and size of backflow preventer being furnished for the project is approved by and has a current "Certificate of Approval" from the Foundation for Cross Connection Control and Hydraulic Research, University of Southern California (FCCCHR). Listing of the particular make, model/design, and size in the current FCCCHR List of Approved Backflow Prevention Assemblies will be acceptable as the required proof.

2.02 MISCELLANEOUS PIPING MATERIALS

A. Pipe Nipples: ANSI B16, copper alloy for use in copper tubing and hot dip galvanized Schedule 80 steel pipe for use in steel piping.

B. Unions: ANSI B16 for use in copper tubing; ANSI B16.39 hot dip galvanized steel for use in steel piping.

C. Flanges: ANSI B16.1, Class 125, for use in ferrous piping; ANSI B16.22 or ANSI B16.24 for use in copper tubing; with full face flat type synthetic rubber gaskets.

D. Escutcheon Plates: One piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces, chromium plated finish on plates in finished spaces, paint finish on plates in unfinished spaces, and with setscrews or other approved positive means to anchor plates in place securely.

E. Pipe Sleeves:
1. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: ASTM A53 or ASTM A120, Schedule 40 or Standard Weight, hot dip galvanized steel pipe sleeves.
2. Sleeves in Partitions and Other Than Masonry and Concrete Walls, Floors, and Roofs: Hot dip galvanized steel sheet having a nominal weight of not less than 0.90 pounds per square foot.

F. Pipe Hangers and Supports: Provide MSS SP 58 and MSS SP 69, Type 1 or 6, of the adjustable type, except as modified herein or indicated otherwise. Attachments to steel W or S beams shall be with Type 21, 28, 29, or 30 clamps. Attachments to steel angles and channels (with web vertical) shall be with Type 20 clamp with a beam clamp channel adaptor. Attachments to steel channel web horizontal) shall be with drilled hole on center line and double nut and washer. Attachments to concrete shall be with Type 18 insert or a drilled hole with expansion anchor. Attachments to wood shall be as indicated. Hanger rods and

attachments shall be full size of the hanger threaded diameter. Provide Type 40 insulation protection shields for insulated piping. Provide steel support rods. Provide nonmetallic, hair felt, or plastic piping isolators between copper tubing and the hangers.

G. Access Doors: Provide 12 by 12 inch factory prefabricated and primed flush face steel access doors including steel door frame with continuous hinges and turn screw operated latch. Door frame shall be for installation in plaster and masonry walls. Furnish doors under this Section to provide proper access to concealed valves; install doors under the appropriate section of this Specification.

2.03 PIPE, VALVE AND EQUIPMENT INSULATION

A. Section 22 07 00, “Plumbing Insulation”.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of plumbing systems including equipment, materials, and workmanship shall be in accordance with the Plumbing Code of New York State, except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.
   1. Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads.
   2. Solder End Valves: Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.
   3. Pipe Supports (Hangers): Provide additional supports at the concentrated loads in piping between supports, such as for in-line water pumps and flanged valves.
      a. Piping to Receive Insulation: Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under Section 22 07 00, "Plumbing Insulation".
      b. Maximum Spacing Between Supports:
         1) Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals.

2) Horizontal Piping: Support cast iron piping at 5 foot intervals, except for pipe exceeding 5 foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support steel piping and copper tubing as follows:

MAXIMUM SPACING (FEET)						
Nominal Pipe Size (Inches)	One and Under	1.25	1.5	2	2.5	3 and Over
Steel Pipe	7	8	9	10	11	12
Copper Tube	6	6	8	8	9	10

4. Ductile Iron Pipe Aboveground: Provide flanged joints.
5. Installation of Pipe Sleeves: Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation, and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor.

3.02 NAMEPLATES

A. Provide laminated plastic nameplates for equipment, gauges, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125 inch thick melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information.
   1. Manufacturer, type, and model number
   2. Contract number and accepted date
   3. Capacity or size
   4. System in which installed
   5. System which it controls

3.03 FIELD TESTING

A. Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code of New York State, except as modified herein. Correct all defects in the work provided by the Contractor, and repeat the tests until the work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for the tests.

1. Domestic Water Piping: Before insulation is applied, hydrostatically test each piping system at not less than 100 psig with no leakage or reduction in gauge pressure for 2 hours.

3.04 DISINFECTION

A. Thoroughly flush entire system prior to disinfection. Disinfect the new water piping in accordance with AWWA C601. Fill the piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Maintain a minimum of 25 ppm during retention period. Repeat chlorination as required to achieve 25 ppm minimum. Flush the solution from the systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Sanitary Waste and Vent Piping as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
   1. Section 22 00 00 – Plumbing General Requirements
   2. Section 22 42 00 – Commercial Plumbing Fixtures

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
   1. American National Standards Institute (ANSI) Publication:
      a. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
      b. B16.3 – Malleable Iron Threaded Fittings
      c. B16.12 – Cast Iron Threaded Drainage Fittings
      d. B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings
      e. B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
      f. B16.23 – Cast Copper Alloy Solder Joint Drainage Fittings –DWV
      g. B16.24 – Bronze Pipe Flanges and Flanged Fittings, Class 150 and 300
      h. B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes
      i. B16.29 – Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings DWV
      j. B16.32 – Cast Copper Alloy Solder Joint Fittings for Solvent Drainage Systems
      k. B16.39 – Malleable Iron Threaded Pipe Unions, Class 150, 250 and 300
   2. American Society for Testing and Materials (ASTM) Publication:
      a. A47 – Ferritic Malleable Iron Castings
      b. A53 – Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless
      c. A74 – Cast Iron Soil Pipe and Fittings
      d. A120 – Pipe, Steel, Black and Hot Dipped, Zinc Coated (Galvanized) Welded and Seamless for Ordinary Uses
      e. A183 – Carbon Steel Track Bolts and Nuts
      f. A536 – Ductile Iron Castings
      g. B32 – Solder Metal

h. B61 – Steam or Valve Bronze Castings
i. B62 – Composition Bronze or Ounce Metal Castings
j. B88 – Seamless Copper Water Tube
k. B306 – Copper Drainage Tube (DWV)
l. C564 – Rubber Gaskets for Cast Iron Soil Pipe and Fittings
m. D2000 – Classification System for Rubber Products in Automotive Applications
n. D2564 – Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
o. D2661 – Acrylonitrile Butadiene Styrene (ABS) Plastic Drain, Waste, and Vent Pipe and Fittings
p. D2665 – Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

3. American Water Works Association (AWWA) Publication:
   a. C104 – Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fitting for Water
   b. C105 – Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
   c. C110 – Gray Iron and Ductile Iron Fittings, 3 in. Through 48 in. for Water and Other Liquids
   d. C111 – Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
   e. C115 – Flanged Ductile Iron and Gray Iron Pipe with Threaded Flanges
   f. C151 – Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water and Other Liquids
   g. C500 – Gate Valves, 3 Through 48 inch NPS, for Water and Sewage Systems
4. Cast Iron Soil Pipe Institute (CISPI) Publication:
   a. 301 – Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
   b. 310 – Patented Joint for Use in Connection with Hubless Cast Iron Sanitary System
   c. HSN – Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
5. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publication:
   a. SP 58 – Pipe Hangers and Supports-Materials, Design and Manufacture
   b. SP 69 – Pipe Hangers and Supports-Selection and Application
   c. SP 70 – Cast Iron Gate Valves, Flanged and Threaded Ends
   d. SP 80 – Bronze Gate, Globe, Angle and Check Valves
   e. SP 85 – Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
6. Plumbing and Drainage Institute (PDI) Publication:
   a. G101 – Testing and Rating Procedure for Grease Interceptors

7. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 – Plumbing Code of New York State

1.03 GENERAL REQUIREMENTS

A. Section 22 00 00, "Plumbing General Requirements", applies to this Section, with the additions and modifications specified herein. Plumbing systems including equipment, materials, installation, and workmanship shall be in accordance with the Plumbing Code of New York State, except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears. Capacity of equipment shall be not less than that indicated. Plumbing systems shall include all water piping buried and aboveground to a limit of 5 feet outside of the building walls unless otherwise specified, or indicated by the Contract Drawings.

1.04 SUBMITTALS

A. Manufacturer's Data:
   1. Pipe and fittings
   2. Valves
   3. Pipe supports (hangers)
   4. Drains
   5. Cleanouts

B. Certificates of Conformance:
   1. Pipe and fittings

C. Operation and Maintenance Manuals:
   1. Pumps

D. Posted Operating Instructions:
   1. Pumps

E. Certified Data:
   1. Pump test curves

PART 2 - PRODUCTS

2.01 DWV (DRAIN, WASTE, AND VENT) PIPING

A. Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping.
   1. Buried Piping: Buried piping includes piping up to but not more than 6 inches aboveground or floor slab on grade.

a. Cast Iron Hub and Spigot Pipe and Fittings: ASTM A74 with ASTM C564 or CISPI HSN 85 rubber compression gasket joints, or calked and leaded joints.
b. Plastic Pipe, Fittings, and Solvent Cement:
1) Polyvinyl Chloride (PVC) System: ASTM D2665.
2) Acrylonitrile Butadiene Styrene (ABS) System: ASTM D2661, single extrusion pipe.

2. Aboveground Piping:
a. Cast Iron Hubless Pipe and Fittings: CISPI 301 with CISPI 310 coupling joints.
b. Cast Iron Hub and Spigot Pipe and Fittings: ASTM A74 with ASTM C564 or CISPI HSN 85 rubber compression gasket joints, or calked and leaded joints.
c. Plastic Pipe, Fittings, and Solvent Cement:
1) Polyvinyl Chloride (PVC) System: ASTM D2665.
2) Acrylonitrile Butadiene Styrene (ABS) System: ASTM D2661, single extrusion pipe.
d. Copper Tubing: ASTM B306, with ANSI B16.23, ANSI B16.29, or ANSI B16.32 solder joint fittings using ASTM B32, 95 5 tin antimony or Grade Sn96 tin silver solder, and flux containing not more than 0.2 percent lead.
e. Steel Pipe: ASTM A53 or ASTM A120, Schedule 40, hot dip galvanized, threaded end connections; with ANSI B16.12 hot dip galvanized threaded fittings.
f. Grooved End Steel Piping for Roof Drainage Only: ASTM A53 or ASTM A120, Schedule 40, hot dip galvanized, cut grooved end steel pipe; ASTM A47 or ASTM A536, hot dip galvanized, grooved end fittings, and mechanical couplings; ASTM A183 coupling nuts and bolts; ASTM D2000 rubber gaskets for water service. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer.

3. Cleanouts: ANSI A112.36.2M; provide threaded bronze or thermoplastic cleanout plugs.
a. Floor Cleanouts: Provide cast iron floor cleanout with flange, adjustable height polished bronze or nickel bronze rim and scoriated floor plate with "CO" cast in the plate, and countersunk screws for installing floor plate flush with finished floor.
b. Wall Cleanouts: Provide polished stainless steel or chromium plated bronze cover plate and secure to cleanout plug with countersunk screw.
c. Cleanouts Exterior to Buildings: Provide cast iron or polyvinyl chloride (PVC) cleanouts and countersunk plugs. Provide 24 by 24 by 4 inch thick concrete slab with top 1.0 inch above grade with cleanout located in center of slab.

4. Drains: ANSI A112.21.1M; provide cast iron drains and clamping rings for use with membrane waterproofing.
    a. Flush Strainer Floor Drains: Provide with double drainage flange, perforated or slotted cast bronze or nickel bronze strainer, adjustable collar, and P trap. Drains of sizes 2, 3, and 4 inches shall have strainers with minimum free drainage area of 5, 11, and 18 square inches, respectively.
    b. Shower Floor Drains: Provide as specified for flush strainer floor drains, except that PVC drains may be provided for fiberglass shower stalls where fire separation requirements are not violated.
    c. Extended Rim Floor Drains: Provide as specified for flush strainer floor drains, except strainer body shall have 1 inch extended rim installed flush with finished floor.
    d. Roof Drains: ANSI A112.21.2M; provide hot dip galvanized cast iron drains, with minimum of 10 inch diameter body, nonpuncturing flashing clamp device with integral gravel stop and deck clamp, and removable cast iron or polypropylene locking dome. Free area of dome shall be not less than two times the free area of drain outlet. Provide drain flashing ring seat flush with adjacent roof deck, and secure rigidly in place with deck clamp.

2.02 MISCELLANEOUS PIPING MATERIALS

A. Pipe Nipples: ANSI B16, copper alloy for use in copper tubing and hot dip galvanized Schedule 80 steel pipe for use in steel piping.

B. Unions: ANSI B16 for use in copper tubing; ANSI B16.39 hot dip galvanized steel for use in steel piping.

C. Flanges: ANSI B16.1, Class 125, for use in ferrous piping; ANSI B16.22 or ANSI B16.24 for use in copper tubing; with full face flat type synthetic rubber gaskets.

D. Escutcheon Plates: One piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces, chromium plated finish on plates in finished spaces, paint finish on plates in unfinished spaces, and with setscrews or other approved positive means to anchor plates in place securely.

E. Pipe Sleeves:
    1. Sleeves in Masonry and Concrete Walls, Floors, and Roofs: ASTM A53 or ASTM A120, Schedule 40 or Standard Weight, hot dip galvanized steel pipe sleeves.
    2. Sleeves in Partitions and Other Than Masonry and Concrete Walls, Floors, and Roofs: Hot dip galvanized steel sheet having a nominal weight of not less than 0.90 pounds per square foot.

F. Pipe Hangers and Supports: Provide MSS SP 58 and MSS SP 69, Type 1 or 6, of the adjustable type, except as modified herein or indicated otherwise. Attachments to steel W or S beams shall be with Type 21, 28, 29, or 30 clamps. Attachments to steel angles and channels (with web vertical) shall be with Type 20 clamp with a beam clamp channel adaptor. Attachments to steel channel web horizontal) shall be with drilled hole on center line and double nut and washer. Attachments to concrete shall be with Type 18 insert or a drilled hole with expansion anchor. Attachments to wood shall be as indicated. Hanger rods and attachments shall be full size of the hanger threaded diameter. Provide Type 40 insulation protection shields for insulated piping. Provide steel support rods. Provide nonmetallic, hair felt, or plastic piping isolators between copper tubing and the hangers.

G. Access Doors: Provide 12 by 12 inch factory prefabricated and primed flush face steel access doors including steel door frame with continuous hinges and turn screw operated latch. Door frame shall be for installation in plaster and masonry walls. Furnish doors under this Section to provide proper access to concealed valves; install doors under the appropriate section of this Specification.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of sanitary waste and vent systems including equipment, materials, and workmanship shall be in accordance with the Plumbing Code of New York State, except as modified herein. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.

1. Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads.
2. Solder End Valves: Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.
3. Pipe Supports (Hangers): Provide additional supports at the concentrated loads in piping between supports, such as for in-line water pumps and flanged valves.
4. Maximum Spacing Between Supports:
    a. Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals.
    b. Horizontal Piping: Support cast iron piping at 5 foot intervals, except for pipe exceeding 5 foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support steel piping and copper tubing as follows:

MAXIMUM SPACING (FEET)						
Nominal Pipe Size (Inches)	One and Under	1.25	1.5	2	2.5	3 and Over
Steel Pipe	7	8	9	10	11	12
Copper Tube	6	6	8	8	9	10

5. Installation of Pipe Sleeves: Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation, and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes through concrete floor slabs located on grade.

3.02 NAMEPLATES

A. Provide laminated plastic nameplates for equipment and valves. Laminated plastic shall be 0.125 inch thick melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information.
   1. Manufacturer, type, and model number
   2. Contract number and accepted date
   3. Capacity or size
   4. System in which installed
   5. System which it controls

3.03 FIELD TESTING

A. Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code of New York State, except as modified herein. Correct all defects in the work provided by the Contractor, and repeat the tests until the work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for the tests.

1. DWV Piping: Before the installation of fixtures, cap the ends of each system, fill the piping with water to the roof, and allow to stand a minimum of 3 hours with no measurable leakage. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10 foot head of water.

END OF SECTION

SECTION 22 33 33

COMMERCIAL ELECTRIC DOMESTIC WATER HEATER

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Commercial Electric Domestic Water Heater and circulating pumps, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
   1. Section 22 00 00 – Plumbing General Requirements
   2. Section 22 07 00 – Plumbing Insulation
   3. Section 22 11 16 – Domestic Water Piping
   4. Division 26 – Electrical

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
   1. American National Standards Institute (ANSI) Publication:
      a. Z21.22 – Relief Valves For Hot Water Supply Systems
   2. American Society of Mechanical Engineers (ASME) Publication:
      a. A112.4.1 – Water Heater Relief Valve Drain Tubes
      b. BPVC IV-HLW – Heating Boilers – Lined Potable Water Heaters
      c. BPVSEC8 – Pressure Vessels (Division1)
   3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Publication:
      a. 90.1-2013 – Energy Standard for Buildings Except Low-Rise Residential Buildings
   4. American Society of Sanitary Engineering (ASSE) Publication:
      a. 1005 – Performance of Water Heater Drain Valve (3/4-inch)
      b. 1017 – Performance of Temperature Actuated Mixing Valves for Hot Water Distribution Systems
      c. 1070 – Performance Requirements for Water Temperature Limiting Devices
   5. National Electrical Manufacturers Association (NEMA) Publication:
      a. ICS 6 – Industrial Control and Systems: Enclosures
   6. NSF International (NSF) Publication:
      a. 5 – Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
      b. 61 – Drinking Water System Components – Health Effects
      c. 372 – Drinking Water System Components – Lead Content

7. Underwriters Laboratories, Inc. (UL) Publication:
    a. 94 – Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
    b. 174 – Household Electric Storage Tank Water Heaters
    c. 499 – Electric Heating Appliances
    d. 1453 – Electric Booster and Commercial Storage Tank Water Heaters
8. Uniform Fire Prevention and Building Code of New York State Publication:
    a. 2020 – New York State Plumbing Code
    b. 2020 – New York State Energy Conservation Code

1.03 SUBMITTALS

A. Manufacturer's Data:
    1. Water Heaters
    2. Pump
    3. Expansion Tank
    4. Thermostatic Mixing Valve

B. Certificates of Conformance:
    1. Water Heaters
    2. Pump
    3. Expansion Tank
    4. Thermostatic Mixing Valve

C. Operation and Maintenance Manuals:
    1. Water Heaters
    2. Pump
    3. Expansion Tank
    4. Thermostatic Mixing Valve

PART 2 - PRODUCTS

2.01 DOMESTIC ELECTRIC WATER HEATERS

A. Unit shall be electric domestic hot water heater with insulated seamless glass-lined steel tank construction meeting ASME pressure vessel code, with electrical junction box and heavy duty terminal block. Unit power shall be rated at 208volts, three phase, 60 cycle AC. Tank shall be cathodically protected with two anode rods. Water heater shall have heavy duty medium watt density heating elements with incoloy sheathing, and controlled by individually mounted thermostat and high temperature cutoff switch. Internal circuits shall be fused. Unit shall be equipped with an adjustable range thermostat to allow hot water settings between 120°F and 181°F and shall meet or exceed all scheduled performance ratings. Hot water heater shall meet ASHRAE 90.1 standard, shall be UL listed and

certified, and approved to NSF 5 standard. Unit shall include all scheduled or specified features and meet or exceed all scheduled and specified performance characteristics. Manufacture shall be as by AO Smith Gold Series DRE, or approved equal.

B. Combination Pressure and Temperature Relief Valve: ASME and ANSI Z21.22 rated temperature and pressure relief valve set at not less than 25 psi above maximum system pressure, not to exceed maximum working pressure, and temperature relief setting not to exceed 210°F. Provide with test lever.

2.02 PUMP

A. Submit the manufacturer's certified characteristic performance curve for the impeller size to be furnished. Select the pump so that the operating point on the characteristic performance curve for the impeller size to be furnished will be to the left (shut-off side) of and not more than 5 percent below the point of maximum efficiency for the impeller to be furnished.

B. Circulating Inline Water Pumps (DWCP-1): Circulating pump shall be inline type, all bronze construction suitable for potable water, with performance characteristics as scheduled. Manufacture shall be as by Bell and Gossett, Model NBF, or equal. Provide UL approved timer kit and aquastat to control circulating pump using both water temperature and time of day. Manufacture shall be as by Bell and Gossett Model TC-1 and AQS-3/4, or equal.

2.03 EXPANSION TANK

A. Expansion tank to be welded steel, and constructed and tested hydrostatically in accordance with ASME BPVSEC8 of the Boiler Pressure Vessel Code and stamped 125 psi working pressure. Tank shall be suitable for use with potable water and have integral heavy-duty butyl rubber diaphragm, .302”-32 charging valve connection, drain, and system connection. Expansion Tank shall be as manufactured by Bell & Gossett Model PTA-12, or approved equal.

2.04 THERMOSTATIC MIXING VALVE

A. Valve to be lead free brass body and rotatable union triple-duty check stops, rough bronze finish, ASSE 1017 listed, paraffin-based thermal actuation technology, and a vandal-resistant lockable temperature-setting feature with an outlet temperature range of 90°F to 160°F. Manufacture shall be as by Powers HydroGuard XP Master Series LFMM432, or approved equal.

2.05 INSULATION

A. Section 22 07 00, “Plumbing Insulation”.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of domestic water heater systems including equipment, materials, and workmanship shall be in accordance with the New York State Plumbing Code and New York State Energy Conservation Code, except as modified herein.
   1. Water heaters shall be installed level and plumb and securely anchored.
   2. Water heaters shall be installed and connected in accordance with manufacturer's written instructions with manufacturer's recommended clearances.

3.02 TESTING

A. Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Correct all defects in the work provided by the Contractor, and repeat the tests until the work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for the tests.

3.03 DISINFECTION

A. Thoroughly flush entire system prior to disinfection. Disinfect the new water piping in accordance with AWWA C601. Fill the piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Maintain a minimum of 25 ppm during retention period. Repeat chlorination as required to achieve 25 ppm minimum. Flush the solution from the systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million.

3.04 INSTRUCTION OF OPERATING PERSONNEL

A. Upon completion of the work, and acceptance of the installation, and at a time designated by the Owner, the services of a competent technician regularly employed or authorized by the manufacturer of the system shall be provided for instructing personnel in the proper operation, maintenance, safety and emergency procedures. The period of instruction shall be not less than four hours. The training shall be conducted at the job site during actual operation and coordinated with the Owner one week in advance.

END OF SECTION

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Commercial Plumbing Fixtures, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Section 22 00 00 – Plumbing General Requirements
2. Section 22 07 00 – Plumbing Insulation
3. Section 22 11 16 – Domestic Water Piping
4. Section 22 13 16 – Sanitary Waste and Vent Piping
5. Division 26 – Electrical

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
1. American National Standards Institute (ANSI) Publication:
a. Z124.1 – Plastic Bathtub Units
b. Z124.2 – Gel Coated Glass Fiber Reinforced Polyester Resin Shower Receptors and Shower Stall Units
c. Z358.1 – Emergency Eye Wash and Shower Equipment
2. American Society of Mechanical Engineers (ASME) Publication:
a. A112.6.1M – Supports for Off the Floor Plumbing Fixtures for Public Use
b. A112.6.2 – Framing-Affixed Supports (Carriers) for Off-the-Floor Plumbing Fixtures
c. A112.18.1 – Plumbing Supply Fittings
d. A112.18.2 – Plumbing Waste Fittings
e. A112.19.1 – Enameled Cast Iron Plumbing Fixtures
f. A112.19.2 – Ceramic Plumbing Fixtures
g. A112.19.3 – Stainless Steel Plumbing Fixtures
h. A112.19.4M – Porcelain Enameled Formed Steel Plumbing Fixtures
i. A112.19.5 – Flush Valves and Spuds for Water Closet Bowls, Tanks, and Urinals
j. A112.19.14 – Six Liter Water Closets Equipped with a Dual Flushing Device
3. American Society of Sanitary Engineering (ASSE) Publication:
a. 1001 – Atmospheric Type Vacuum Breakers

b. 1016 – Individual Thermostatic, Pressure Balancing and Combination Balancing and Thermostatic Control Valves for Individual Fixture Fittings
c. 1037 – Pressurized Flushing Devices for Plumbing Fixtures
d. 1070 – Water Temperature Limiting Devices

4. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Publication:
   a. 18 – Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration
5. National Electrical Manufacturers Association (NEMA) Publication:
   a. ICS 6 – Industrial Control and Systems: Enclosures
6. NSF International (NSF) Publication:
   a. 61 – Drinking Water System Components – Health Effects
   b. 372 – Drinking Water System Components – Lead Content
7. Underwriters Laboratories, Inc. (UL) Publication:
   a. 399 – Drinking-Water Coolers
8. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 – New York State Plumbing Code
   b. 2020 – New York State Energy Conservation Code

1.03 GENERAL REQUIREMENTS

A. Section 22 00 00, "Plumbing General Requirements", applies to this Section, with the additions and modifications specified herein. Plumbing systems including equipment, materials, installation, and workmanship shall be in accordance with the New York State Plumbing Code and New York State Energy Conservation Code, except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears.

1.04 SUBMITTALS

A. Manufacturer’s Data:
   1. Plumbing Fixtures

B. Certificates of Conformance:
   1. Water flushing volume of flushometer and water closet combination
   2. Water flushing volume of flushometer and urinal combination

PART 2 - PRODUCTS

2.01 FIXTURES, FITTINGS, ACCESSORIES, AND SUPPLIES:

A. Provide control stop valves in each supply to each fixture. The finish of fittings, accessories, and supplies exposed to view shall be chromium plated per ASME A112.18.1. Center set faucets shall be top mounted with inlets on not greater than 4 inch centers, unless noted otherwise.

1. Tank Type Water Closets (P-1): ASME A112.19.2, close coupled, white vitreous china, ASME A112.19.14, floor mounted, floor outlet, pressure assist siphon jet, elongated bowl, ADA compliant bowl rim at 17 inches, and white solid plastic elongated open front seat. The water flushing volume shall not exceed 1.1 gallons per flush from 25 to 80 psi. Manufacture shall be as by American Standard Cadet Model 2467.100, or approved equal.
2. Lavatories (P-2): ASME A112.19.2 white vitreous china with ASME 112.6.1 concealed arm carrier support, shelf back type, minimum dimensions of 20 inches wide by 18 inches front to rear. Provide ASME 112.18.1 copper alloy 4-inch center set faucets with 0.5 gpm pressure compensating stationary spout and ADA compliant vandal-resistant level handles. Provide with perforated grid strainer drain fittings, and 1.25 inch adjustable P traps. Manufacture shall be as by American Standard Lucerne Model 0355.912, or approved equal. Lavatory faucet manufacture shall be as by American Standard Monterrey Model 5502.145, or approved equal.
3. Counter Top Sink Faucets (P-3): Provide top mounted ASME A112.18.1 copper alloy 4-inch center set faucets with 0.5 gpm pressure compensating stationary spout, ADA compliant vandal-resistant lever handles, and perforated grid strainer drain fittings. Provide 1.5 inch adjustable P trap with drain piping to vertical vent stack. Manufacture shall be as by American Standard Monterrey Model 5502.145, or approved equal.
4. Electric Water Cooler (P-4): ASHRAE 18, ASME A112.19.3, ADA compliant wall-mounted bubbler style Bottle Filling Station and Bi-Level Cooler with ASME A112.6.1 concealed chair carrier, air-cooled condensing unit, 8.0 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27-inch minimum knee clearance from front to bottom of unit to floor and 36-inch maximum spout height above floor. Bubblers shall also be controlled by electronic push bars, one on front and sides of the cabinet. Manufacture shall be as by Elkay Model EZSTL8WSSK, or approved equal.
5. Security Water Closet/Lavatory Combination (P-5): ASME A112.19.3, ADA compliant, 14-gauge 304 stainless steel, seamless welded with satin finish on exposed surfaces, suicide resistant combination water closet/lavatory combination. Unit to include 36-inch minimum long stainless steel grab bar located behind toilet. Lavatory shall have pneumatically operated dual temperature, metering, push button valve complying with NSF 61, Section 9-1997 lead free requirements, and

hemispherical penal bubbler and pushbutton. Valve shall be air-control pneumatically operated using atmospheric air and metering with non-hold open feature, adjustable from 5 to 60 seconds and remotely located. Water closet shall be concealed blowout jet type with elongated bowl, wall outlet, self-draining flushing rim, integral contoured seat, mechanical flush valve, flushing volume not to exceed 1.28 gallons per flush at 25 psi, minimum 3-1/2 inch trap seal to pass a 2-1/8 inch diameter ball, and fully enclosed. Cabinet interior shall be sound-deadened with fire-resistant material. Fixture shall withstand loading of 5,000 lbs. without permanent damage. Access shall be through removal panels on the face of the cabinet, on the open side of the cabinet and below the lavy section with vandal resistant fasteners. Manufacture shall be as by Acorn Model 1449FA, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of plumbing systems including fixtures, equipment, materials, and workmanship shall be in accordance with the New York State Plumbing Code, except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.

1. Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads.
2. Solder End Valves: Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.
3. Pipe Supports (Hangers): Provide additional supports at the concentrated loads in piping between supports, such as for in-line water pumps and flanged valves.

3.02 NAMEPLATES

A. Provide laminated plastic nameplates for equipment, gauges, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125 inch thick melamine plastic, black with white center core. Surface shall be a matte finish. All corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each

system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information.

1. Manufacturer, type, and model number
2. Contract number and accepted date
3. Capacity or size
4. System in which installed
5. System which it controls

3.03 FIELD TESTING

A. Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Correct all defects in the work provided by the Contractor, and repeat the tests until the work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for the tests.

END OF SECTION

SECTION 23 05 00

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Mechanical General Requirements, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
   1. Division 1, “General Requirements”
   2. Division 22, “Plumbing”
   3. Division 23, “Mechanical”
   4. Division 26, “Electrical”

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
   1. Code of Federal Regulations (CFR) Publications:
      a. 29-1910 SUBPART O - Machinery and Machine Guarding
      b. 29-1910.219 - Mechanical Power Transmission Apparatus

1.03 SUBMITTALS

A. Submit shop drawings, manufacturer's data, publication compliance, certified test reports, and manufacturer's certificates of compliance for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication or delivery of the items to the job site. Shop drawings shall be accompanied by a letter of transmittal in duplicate, and all shop drawings shall be suitably identified with the name of the project, contract number, Contractor's name, date and initials indicating approval of such submittal by the Contractor under the applicable specification. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and the specific technical paragraph reference which specifies each item, applicable industry and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished.
   1. Manufacturer's Data: Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

2. Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, and installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
3. Manufacturer's Certificates of Compliance: Submit certification from manufacturer attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certifications will not be acceptable; certifications shall be the manufacturer's original; certifications shall be not more than one year old. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conforms to the requirements specified. Certificates shall be signed by the manufacturer's official authorized to sign certificates of compliance.
4. Reference Standards Compliance: Where equipment or materials are specified to conform to industry and technical society reference standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), American Society of Mechanical Engineers (ASME), American Gas Association (AGA), American Refrigeration Institute (ARI), and Underwriters' Laboratories (UL), proof of such conformance shall be submitted. If an organization uses a label or listing to indicate compliance with a particular reference standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections.

B. Independent Testing Organization Certificate: In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing and approved by the Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.04 OPERATION AND MAINTENANCE MANUAL

A. Furnish an operation and maintenance manual for each item of equipment. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual to the Owner's Representative for review and approval not more than 90 calendar days after an item is approved, but at least 60 calendar days prior to field acceptance testing of the item. Furnish the remaining manuals at least 60 days prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL", the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start up, operation and shut down; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shut down instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade, temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

1.05 CATALOGED PRODUCTS

A. Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.06 MANUFACTURER'S RECOMMENDATIONS

A. Unless otherwise stated in the Contract Specifications, all new equipment items, and specialties shall be installed in strict accordance with the recommendations of the manufacturer of the items being installed. Prior to the installation of new items, the Contractor shall submit to the Owner's representative printed copies of the manufacturer's installation recommendations. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material. Failure to install items in accordance with manufacturer's recommendations can be cause for rejection of the work items installed.

1.07 LAYOUT OF THE WORK

A. Coordinate the proper relation of the work to the building structure, existing utilities and to the work of all trades. The Contractor shall advise the Owner's Representative of any discrepancy before performing any work.
   1. Contract Drawings: The Contract Drawings represent the general intent as to piping and equipment arrangements. All locations and dimensions shown shall be field verified and minor alterations made if so required. Where dimensions are not given for the location and arrangement of mechanical systems, locations may be assumed to be approximate, and may be altered if required. Major modifications to the indicated arrangements shall be approved by the Owner's Representative prior to the installation of mechanical systems. Schematic diagrams represent the overall system requirements and do not necessarily indicate the physical orientation, location or dimensions of that system.
   2. Record Drawings: The Contractor shall maintain a record of the progress of the work and shall submit three (3) sets of As-Built Drawings upon completion of the project.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Properly store, adequately protect, and carefully handle equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Engineer. Replace damaged or defective items.

1.09 SAFETY REQUIREMENTS

A. Equipment Safety: Fully enclose or properly guard in accordance with 29 CFR 1910.219 belts, pulleys, chains, gears, couplings, projecting setscrews, keys, rotating parts, and other power transmission apparatus, located where persons can come in close proximity thereto. Points of operation, ingoing nip points, and machinery producing flying chips and sparks shall be guarded in accordance with the applicable portions of 29 CFR 1910 SUBPART O. Provide positive means of locking out equipment so that equipment cannot be accidentally started during

maintenance procedures. High temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified. Provide catwalks, maintenance platforms, and guardrails where required for safe operation and maintenance of equipment. Provide ladders or stairways to reach catwalks and maintenance platforms. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters and tools.

1.10 ELECTRICAL REQUIREMENTS

A. Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Division 26-Electrical. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under this Section. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Division 26 – Electrical. Unless specifically noted otherwise, all control wiring (120 volt or less) shall be provided by Mechanical Contractor and conform to the requirements of Division 26-Electrical.

1.11 INSTRUCTION TO OWNER'S PERSONNEL

A. When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Owner's personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the Contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.12 INSPECTIONS AND CERTIFICATIONS

A. The Contractor shall provide and pay for any third party inspections or certifications required by applicable regulatory agencies for boilers and other mechanical equipment components modified, or furnished and installed as a part of the Contract work.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 FIELD PAINTING

A. Conform to Section 09 91 00 – Painting

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for identification of HVAC piping and equipment including all pumps, fans, VAV boxes, ductwork, piping and valves using color bands, lettering, flow direction arrows, and related permanent identification devices for Identification for HVAC Piping and Equipment, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
   1. Section 23 05 00 – Mechanical General Requirements

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
   1. American National Standards Institute, Inc. (ANSI) Publication:
      a. A13.1 – Scheme for the Identification of Piping Systems
      b. Z535.1 – Safety Color Code

1.03 SUBMITTALS

A. Manufacturer's Data:
   1. Label, Tag and Nameplate materials
   2. List of wording, symbols, letter size, and color coding to be used
   3. Valve chart
   4. Accessory materials

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pipe labels, valve tags and equipment nameplates shall be as manufactured by Marking Services Incorporated, or approved equal.
   1. Nameplates: Three-ply laminated phenolic plastic at least 1/16" thick with black surfaces and white core. Engraving shall be minimum ½" high with appropriate spacing. Text shall be white on black background. Nomenclature shall match the equipment designation as indicated on the Plans and Schedules.

2. Valve Tags: Three-ply laminated phenolic plastic at least 1/16" thick with black surfaces and white core. Engraving shall be minimum ½" high with appropriate spacing. Text shall be white on black background. Valve tag shall be minimum 1-1/2" diameter with smooth edges.
3. Pipe Markers: Color, text and size shall conform to ASME/ANSI Standard A13.1.
    a. Plastic Pipe Markers: Strap-type labels shall be factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering with flow direction arrows and identification of fluid being conveyed. Straps shall be self-locking nylon ties.
    b. Plastic Tape Pipe Markers: Self-adhesive flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings with flow direction arrows and identification of fluid being conveyed.
4. Valve Chart: Valve chart(s) shall be printed on 8-1/2"x11" white paper with typewritten black text, minimum 12 point character size. Information to be provided shall be, at a minimum, the number, location, size and function of each line valve installed under this Contract. Chart shall be installed in a glazed frame and permanently mounted to wall in mechanical room or other suitable location coordinated with the Owner.

PART 3 - EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 GENERAL

A. All markers shall be installed in accordance with manufacturer's printed instructions, and shall be neat and uniform in appearance. All tags or markers shall be oriented such that they are readily visible from all normal working locations. All equipment above lift-out ceilings or made accessible by access doors shall be labeled in the same manner as that of exposed equipment.

3.03 NAMEPLATES

A. Install plastic nameplates with corrosive resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer. Equipment to be labeled shall include but not be limited to the following items: pumps, exhaust fans, air handling units, fan coil units, VAV boxes, condensing units, chillers, heat exchangers, hot water heaters, boilers, storage tanks, water treatment equipment, air compressors, HVAC control devices and dampers, switches, control panels and other related devices.

3.04 VALVE TAGS

A. Install valve tags on all valves except simple service and drain valves located within 10 feet and sight distance of the device or equipment served. For example, it would not be expected that strainer blow-down values in a machine room would be tagged. Each tag shall be attached to its valve with copper clad annealed iron wire, corrosion resistant chain, or other approved material.

3.05 PIPE MARKERS

A. Exposed piping shall be identified at intervals of 20 feet and at least one time in each room. Provide a pipe marker at each valve. Provide arrow markers at each pipe marker with arrows pointing away from the pipe marker to indicate direction of flow. When flow can be in either or both directions, provide a double ended arrow marker. Provide pipe and arrow marker at every point of pipe entry or exit where line penetrates a wall or service chase. Self-adhesive labels shall be used to identify piping under 6 inches in diameter when insulated and covered. For finished pipe sizes 6 inches and larger, strap type markers with self-locking nylon ties shall be utilized.

3.06 MISCELLANEOUS EQUIPMENT

A. Small items such as inline pumps shall be identified with tags in lieu of nameplates. Submit labeling plan to Engineer for devices and equipment not otherwise specified herein.

END OF SECTION

SECTION 23 05 93

TESTING AND BALANCING AIR AND WATER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Testing and Balancing Air and Water Systems as shown on the Plans, as specified, and/or directed.

B. Related work specified elsewhere:
   1. Division 1 – General Requirements
   2. Division 23 – Mechanical

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
   1. Associated Air Balance Council (AABC) Publication:
      a. National Standards for Total System Balance (NSFTSB)
   2. National Environmental Balancing Bureau (NEBB) Publication:
      a. Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems
   3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Publication:
      a. ASHRAE Handbook of Fundamentals
   4. American National Standards Institute (ANSI) Publication:
      a. S1.4 - Specification for Sound Level Meters
      b. S1.11 - Specifications for Octave and Third-
      c. Octave Band Filter Sets

1.03 DEFINITIONS

A. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment, (e.g., reduce fan speed, throttling, etc.)

B. Procedure: Standardize approach and execution of sequence of work operations to yield reproducible results.

C. Report Forms: Test data sheets arranged for collection of test data in logical order to submission and review. This data should also form the permanent record which shall be used as the basis for any future testing, adjusting, and balancing required.

D. Test: To determine quantitative performance of equipment.

1.04 SUBMITTALS

A. An agenda shall be submitted and approved by the Engineer prior to start of testing and balancing work. Include the following:
   1. General description of each air and water system with its associated equipment, and operation cycles for heating, intermediate and cooling. Where different cycles are used for day and night, they shall be described independently.
   2. A complete listing of all air and water flow and air terminal measurements to be performed.
   3. Proposed selection points for sound measurements. List shall include typical spaces and sound sensitive areas including specifically auditoriums and conference rooms.
   4. Specific test procedures and parameters for determining specified quantities; e.g., flow drafts, sound levels, etc., from the actual field measurements to establish compliance with Contract requirements.
   5. Samples of forms showing applications of procedures and calculations to typical systems.

B. Standards Compliance:
   1. Testing Agency
   2. Testing Agency Personnel
   3. Professional Engineers
   4. Instrument Calibration

C. Schedules:
   1. Testing Agenda

D. Reports:
   1. Preliminary Report
   2. Certified Report

1.05 TESTING AND BALANCING AGENCY

A. Air and Water Systems Testing and Balancing: Upon completion of the installation and field testing performance test and adjust the supply, return, make-up, and exhaust air systems, and chilled and heating water systems to provide the air volume and water flow quantities indicated and sound levels required. Accomplish all work in accordance with the agenda and procedures specified and AABC NSFTSB and standards of the National Environmental Balancing Bureau (NEBB). Correct air and water system performance deficiencies disclosed by the test before balancing the systems.

B. Agency Qualifications: The Contractor, as part of this Contract shall obtain the services of a qualified testing organization to perform the testing and balancing work as herein specified. Prior to commencing work under this Section of Specifications, the testing organization shall have been approved by the Engineer.

The criteria for determining qualifications shall be membership in the Associated Air Balance Council (AABC), or certification by the National Environmental Balancing Bureau.

C. Owner Selection: If the Contractor fails to submit the name of an acceptable agency, the Engineer may select a firm to accomplish the work, and the selection shall be binding upon the Contractor at no additional cost to the Owner.

1.06 TESTING AGENDA

A. Preliminary Report: Review Plans and Specifications prior to installation of any of the affected system. Submit a written report to the Engineer indicating any deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the systems.

B. Procedure Reporting: Provide specific test procedures for measuring air quantities at terminals. Specify type of instrument to be used, method of instrument application (by sketch), and factors for:
   1. Air terminal configuration
   2. Flow direction (supply or exhaust)
   3. Velocity corrections
   4. Density corrections (unless applicable data are covered elsewhere)

1.07 PROCEDURES AND INSTRUMENTS, GENERAL

A. Requirements: Adjust systems and components thereof that perform as required by Drawings and Specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans and other equipment shall be of not less than four hours duration, after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda. Furnish all personnel, instruments and equipment for tests specified herein.
   1. Accuracy of Instruments: Instruments used for measurements shall be accurate. Provide calibration histories for each instrument for examination. Calibrate each test instrument by an approved laboratory or by the manufacturer. The Engineer has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.
   2. Application of Instruments: Comply with manufacturer's certified instructions.
   3. Permanently-Installed Instruments: Do not install permanently-installed equipment used for the tests, e.g., gages, thermometers, etc., until just prior to the tests to avoid damage and changes in calibration.

4. Accuracy of All Thermometers: Plus or minus 1 graduation at the temperatures to be measured. Gradations shall conform with the following schedule:

Medium	Design Temperature Differential (°F)	Maximum Graduation (°F)
Air	10 or less	1/2
Air	over 10	1
Water	10 or less	1/10
Water	10-20	1/2
Water	over 20	1

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust all air handling systems to provide the required design air quantity to, or through, each component. Conduct adjusting and balancing of systems during periods of the year approximating maximum seasonal operation.

B. Equalizers: Adjust equalizing devices to provide uniform velocity across the inlets (duct side for supply of terminals, prior to measuring flow rates).

C. Balance: Use flow adjusting (volume control) devices to balance air quantities only, i.e., proportion flow between various terminals comprising system, and only to the extent that their adjustments do not create objectionable air motion or sound, i.e., in excess of specified limits.
   1. Balancing between runs (submains, branch mains and branches): Use flow regulating devices at, or in, the divided - flow fitting. Minimize restriction imposed by flow regulating devices in or at terminals.
   2. Final Measurements of Air Quantity: Make final measurements of air quantity, after the air terminal has been adjusted to provide the optimum air patterns of diffusion.

D. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds, or axial-flow fan wheel blade pitch. For systems with direct-connected fans (without adjustable pitch blades), damper restrictions of a system's total flow may be used, only if system pressure is less than 1/2-inch w.g. and sound level criteria is met.

E. Air Measurements and Balancing:

1. Pitot Tube: Except as specifically indicated herein, make pitot tube traverses of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform with the ASHRAE Handbook Fundamentals.
2. Pitot Tube Traverse: Except for ducts serving modular office area with movable partitions, which are subject to change, pitot-tube traverse may be omitted if the duct serves only a single room or space and its design volume is less than 200 cfm. In lieu of pitot-tube traverse, determine airflow in the duct by totaling volume of individual terminals served, measured as described herein.
3. Test Holes: Test holes, specified in Section entitled Ductwork and Accessories, shall be in a straight duct, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.
4. Air Terminal Balancing: Measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for balancing agenda. Conduct laboratory tests to prove accuracy of methodology when so directed by the Engineer. Perform such tests in conformance with ASHRAE Standards.
5. Air Motion and Distribution: As indicated. The Contractor, in addition to air motion measurements, shall make smoke tests wherever requested by the Engineer, to demonstrate the air distribution from air terminals.

3.02 WATER SYSTEM PROCEDURES

A. Adjustment: Adjust heating, cooling, and condensing water systems to provide required quantity to, or through each component.

B. Metering: Measure water quantities and pressures with calibrated meters.

C. Water Measurements and Balancing: Use venturi tubes, orifices, or other metering fittings and pressure gages. Adjust systems to provide the approved pressure drops through the heat transfer equipment (coils (except room units), converters, etc.), prior to the capacity testing. Where flow metering fittings are not installed, determine flow balance by measuring temperature differential across the heat transfer equipment. Perform measurement of temperature differential with the air system, adjusted as described herein, in operation.

D. Automatic Controls: Position automatic control valves for full flow through the heat transfer equipment of the system during tests.

E. Flow: Flow through bypass circuits at three-way valves shall be adjusted to balance that through the supply circuit.

F. Distribution: Adjust distribution by means of balancing devices (cocks, valves and fittings) and automatic flow control valves. Do not use service valves for adjustment. Where automatic flow control valves are utilized in lieu of venturi tubes, record only pressure drop across the valve if said pressure drop is within the pressure drop rating on the valve tag.

3.03 SOUND TEST PROCEDURES

A. General: Tests to demonstrate compliance with sound requirements shall be made at each selection point included in the agenda.

B. Timing: Take sound level measurements at times when the building is unoccupied, or when activity in surrounding areas and background noise levels in areas tested are at minimum and relatively free from sudden changes in noise levels. Take measurements with all equipment secured, except that being tested. Measure sound levels at any point within a room not less than 6 feet from an air terminal or room unit, and not closer than 3 feet from any floor, wall, or ceiling surface.

C. Meters: Measure sound levels with a sound meter complying with the latest ANSI S1.4. Use the "A" scale to measure overall sound levels. To determine the specified octave band levels, the above sound levels meter, set on "C" scale, shall be supplemented by an Octave Band Analyzer complying with ANSI S1.11.

D. Equipment Components: Determine "equipment components" of room sound (noise) levels for each (of eight) octave bands as follows:
1. Measure room sound pressure level "LPb" with equipment to be tested shut off.
2. Measure room sound pressure level "LPt" with equipment to be tested turned on.
3. Calculate LPt-LPb; if this value is less than 1, applicable test must be rerun with lower background level (LPb) unless LPt is within sound pressure level specified for equipment.
4. Determine "C" from table below:

Lpt-LPb (dB)	1	2	3	4-4-1/2	5-5-1/2	6-7-1/2	8-12	Over 12
C	7	4	3	2	1-1/2	1	1/2	O

5. The "equipment component" of room sound level equals LPt-c.

3.04 REPORTS

A. Submittal: Submit three copies of the reports described herein, covering air and water system performance air motion (fpm), and sound pressure levels, to the Engineer prior to final tests and inspection.

B. Instrument Records: Include types, serial numbers, and dates calibration of all instruments.

C. Reports: Reports shall identify conspicuously items not conforming to contract requirements, or obvious mal-operation and design deficiencies.

D. Certification: The reports shall be certified by an independent Registered Professional Engineer who is versed in the field or air and water balancing and who is not affiliated with any firm involved in the design or construction phases of the project. Certification shall include checking or adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.05 AIR SYSTEM DATA

A. The certified report shall include for each air-handling system the data listed below:
   1. Equipment (fan or factory-fabricated station unit):
      a. Installation Data:
         1) Manufacturer and Model
         2) Size
         3) Arrangement, Discharge, and Class
         4) Motor H.P., Voltage, Phase, Cycles, and Full Load Amps
         5) Location and Local Identification Data
      b. Design data: Data listed in schedules on Drawings and Specifications.
      c. Fan Recorded (Test) Data:
         1) C.F.M.
         2) Static Pressure
         3) R.P.M.
         4) Motor Operating Amps
         5) Motor Operating B.H.P.
   2. Duct Systems:
      a. Duct Air Quantities (Maximum and Minimum) - Main, Submains, Branches, Outdoor (Outside) Air, Total-air, and Exhaust
      b. Individual Air Terminals:
         1) Terminal Identification (Supply or Exhaust Location and Number Designation
         2) Type Size, Manufacturer and Catalog Identification
         3) Design and Recorded Quantities - C.F.M.
         4) Deflector Vane or Diffusion Cone Settings
         5) Applicable Factor for Application, Velocity, Area, etc.
         6) Design and Recorded Velocities - F.P.M. (State "core", "inlet", etc., as applicable)

3.06 WATER SYSTEM DATA

A. Include reports listed below
   1. Pumps:
      a. Installation Data:
         1) Manufacturer and Model
         2) Size
         3) Type Drive
         4) Motor H.P., Voltage, Phase, and Full Load Amps.
      b. Design Data:
         1) G.P.M.
         2) Head
         3) R.P.M.
         4) B.H.P. and Amps
      c. Recorded Data:
         1) Discharge Pressures (Full-Flow and No-Flow)
         2) Suction Pressures (Full-Flow and No-Flow)
         3) Operating Head
         4) Operating G.P.M. (From pump curves if metering is not provided)
         5) No-Load Amps (where possible)
         6) Full-Flow Amps
         7) No-Flow Amps
   2. Steam Heating Equipment:
      a. Installation Data:
         1) Manufacturer, Model and Type
         2) G.P.M.
         3) Inlet (entering) and Outlet (leaving) Temperatures
         4) Water Pressure Drop
      b. Recorded Data:
         1) G.P.M. (if metered)
         2) Entering and Leaving Water Temperature - System
         3) Water pressure drop
         4) Heating (or Cooling) Media Steam Pressure and Temperature and Condensate Temperature, or Entering and Leaving Water Temperature
         5) Heating (or Cooling) Media - Flow (G.P.M. or lbs. per hour)
   3. Air Heating and Cooling Equipment:
      a. Design Data:
         1) Load in B.t.u.h. or MBH
         2) G.P.M.
         3) Entering and Leaving Water Temperature
         4) Entering and Leaving Air Conditions (D.B. and W.B.)
         5) C.F.M.
         6) Water Pressure Drop

b. Recorded Data:
1) Type of Equipment and Identification (location or number designation)
2) Entering and Leaving Air Conditions (D.B. and W.B.)
3) Entering and Leaving Water Temperatures
4) G.P.M. (if metered)
5) Temperature Rise or Drop

4. Water Chilling Units:
a. Installation Data:
1) Manufacturer and Model
2) Motor H.P., Voltage, Cycles, Phase, and Full Load Amps
3) Part Load Amperes
4) G.P.M. - Chiller and Condenser
5) Water Pressure Drop - Chiller and Condenser
b. Recorded Data (Chiller and Condenser):
1) G.P.M.
2) Water Pressure Drop
3) Entering and Leaving Water Temperature
4) Amperes
c. Recorded Data (Air-Cooled Condensers):
1) CFM and R.P.M. of fan
2) Condenser pressure and temperature
3) Entering and leaving air temperature

3.07 SOUND LEVEL DATA

A. Report: Record data on sound levels taken at each selected location, as follows:
1. Source of sound and location.
2. Diagram or description of relationship of sound source to measuring instrument.
3. "A" scale readings:
a. Equipment being tested turned off (ambient)
b. Equipment being tested turned on (operating conditions)
4. Reading at each specified octave band frequency:
a. Equipment being tested turned off (ambient)
b. Equipment being tested turned on (operating condition)
5. "Equipment components" of sound (noise) levels with applicable calculations per "Sound Test Procedure".
6. Graph showing relationship between pressure levels specified and recorded readings.

B. Retest: Subsequent to any correctional construction work, such as acoustic corrections, make measurements to verify that associated air and water quantities, as previously measured, have not been disrupted.

C. Certified Report; Record all sound data, and their locations, after final adjustments or air and water systems involved.

3.08 FIELD TEST

A. General: Make tests to demonstrate that capacities and general performance of air and water systems comply with Contract requirements.
   1. Final Inspection; At the time of final inspection, the Contractor shall recheck, in the presence of the Engineer, random selections of data water and air quantities, air motion and sound levels recorded in the Certified Report. In addition, all Courtrooms, Auditoriums, and Conference Rooms shall be rechecked.
   2. Points and areas for recheck: As selected by the Engineer.
   3. Measurement and Test Procedures: As approved for work forming basis of Certified Report.
   4. Selections for Recheck (Specific Plus Random): In general, selections for recheck will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

B. Retests: If random tests elicit a measured flow deviation of ten percent or more from, or a sound level of 2 Db or more greater than that recorded in the Certified Report listings, at ten percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new Certified Reports submitted, and new inspection tests made.

C. Marking of Settings: Following final acceptance of Certified Reports by the Owner, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor, so that adjustment can be restored if disturbed at any time. Do not mark devices until after final acceptance.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for HVAC Insulation as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Section 23 05 00 – Mechanical General Requirements
2. Section 23 05 53 – Identification for HVAC Piping and Equipment
3. Section 23 21 13 – Hydronic Piping and Specialties
4. Section 23 21 23 – Hydronic Pumps
5. Section 23 31 13 – Ductwork and Ductwork Accessories
6. Section 23 52 16 – Condensing Boilers

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
1. American Society for Testing and Materials (ASTM) Publication:
a. A167 - Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet and Strip
b. C177 - Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus, Test Method
c. C195 - Mineral Fiber Thermal Insulating Cement
d. C533 - Calcium Silicate Block and Pipe Thermal Insulation
e. C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
f. C547 - Mineral Fiber Pipe Insulation
g. C552 - Cellular Glass Thermal Insulation
h. C553 - Mineral Fiber Blanket and Felt Insulation for Commercial and Industrial Applications
i. C592 - Mineral Fiber Blanket Insulation and Blanket Type Pipe Insulation (Metal Mesh Covered) (Industrial Type)
j. C612 - Mineral Fiber Block and Board Thermal Insulation
k. C795 - Thermal Insulation for Use in Contact with Austenitic Stainless Steel
l. C916 - Adhesives for Duct Thermal Insulation
m. C921 - Properties of Jacketing Materials for Thermal Insulation
n. D227 - Coal Tar Saturated Organic Felt Used in Roofing and Waterproofing
o. E84 - Surface Burning Characteristics of Building Materials

p. E96 - Water Vapor Transmission of Materials

2. Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS) Publication:
   a. SP58 - Pipe Hangers and Supports Materials, Design, and Manufacture
   b. SP69 - Pipe Hangers and Supports Selection and Application
3. National Fire Protection Association (NFPA) Publication:
   a. 255 - Surface Burning Characteristics of Building Materials
4. Underwriters Laboratories, Inc. (UL) Publication:
   a. 723 - Tests for Surface Burning Characteristics of Building Materials
5. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 Energy Conservation Construction Code

1.03 SUBMITTALS

A. Manufacturer’s Data:
   1. Insulation
   2. Jackets
   3. Casings
   4. Vapor barrier materials
   5. Accessory materials

B. Standards Compliant: Standards compliance labels are required on each container or package:
   1. Insulation
   2. Jackets
   3. Casings
   4. Vapor barrier materials
   5. Accessory materials

1.04 DEFINITIONS

A. Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.

B. Unfinished Spaces: Spaces used for storage or work areas where appearance is not a factor, such as unexcavated spaces and crawl space.

C. Concealed Spaces: Spaces out of sight. For example, above ceilings; below floors; between double walls; furred in areas; pipe and duct shafts; and similar spaces.

D. Exposed: Open to view. For example, pipe running through a room and not covered by other construction.

E. Fugitive Treatments: Treatments subject to deterioration due to aging, moisture, high humidity, oxygen, ozone, and heat. Fugitive materials are entrapped materials that can cause deterioration, such as solvents and water vapor.

F. Outside: Open to view up to 5 feet beyond the exterior side of walls, above the roof, and unexcavated or crawl spaces.

1.05 MANUFACTURER'S STAMP OR LABEL

A. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation packages and containers shall be asbestos free.

1.06 FLAME SPREAD AND SMOKE DEVELOPED RATINGS

A. In accordance with NFPA 255, ASTM E84 or UL 723, the materials shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50.
   1. Materials Tests: Test factory applied materials as assembled. Field applied materials may be tested individually. Use no fugitive or corrosive treatments to impart flame resistance. UL label or satisfactory certified test report from a testing laboratory will be required to indicate that fire hazard ratings for materials proposed for use do not exceed those specified. Flame proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.
   2. Materials Exempt From Fire Resistant Rating: Nylon anchors.
   3. Materials Exempt from Fire Resistant Rating When Installed In Outside Locations, Buried, or Encased In Concrete: PVC casing and glass fiber reinforced plastic casing.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS INSULATION

A. Piping systems (except buried pipe) requiring insulation, types of insulation required, and insulation thickness shall be as listed in Tables I and II herein. Except for flexible unicellular insulation, insulation thicknesses as specified in Table II shall be one inch greater for insulated piping systems located outside. Unless otherwise specified, insulate all fittings, flanges, and valves, except valve stems, hand wheels, and operators. Use factory premolded, precut, or field fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling. Pipe insulation shall conform to the referenced publications in Table I.

1. Flexible Unicellular Insulation: ASTM C534. The minimum density limit of 4.5 pounds per cubic foot may be waived if all other characteristics of the standard are met.
2. Wicking Type Insulation: ASTM C795. Use over austenitic stainless steel.
3. Piping Insulation Finishes:
    a. All Purpose Jacket: Except calcium silicate and unicellular insulation, provide a factory applied all-purpose jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting. Allow a maximum water vapor permeance of 0.05 perm per ASTM E96, a puncture resistance of not less than 50 Beach units, and a minimum tensile strength of 35 pounds force per inch of width.
    b. Vapor Barrier Material: Resistant to flame, moisture penetration, and mold growth. Provide vapor barrier material on pipe insulation as required in Table I.

2.02 DUCTS (HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS (HVAC)) INSULATION

A. Duct Insulation in Concealed Spaces: Two inch thick mineral fiber flexible resilient blanket insulation with a maximum insulation rating (installed) of R-6, and a maximum conductivity of 0.31 btu in/per hr sq. ft. degree F at 75 degrees F mean temperature as tested in accordance with ASTM C518.

B. Duct Insulation Not in Concealed Spaces: Mineral fiber per ASTM C612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf (pounds per cubic foot) average, 1-1/2 inch thick, inside the building, and a minimum insulation rating (installed) of R-6.

C. Wicking Type Insulation: ASTM C795. Use over austenitic stainless steel surfaces.

D. Acoustically Lined Ducts: For ductwork indicated or specified in Section 233113, "Ductwork and Accessories", to be acoustically lined, provide external insulation as specified in paragraph "Duct Insulation Not In Concealed Spaces".

E. Duct Insulation Finishes:
1. All Purpose Jacket: Provide a factory applied all-purpose jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting. All purpose jacket shall have a maximum water vapor permeance of 0.05 perm per ASTM E96; a puncture resistance of not less than 50 Beach units; and a tensile strength of not less than 35 pounds force per inch of width.

2. Vapor Barrier Material: Material shall be resistant to flame, moisture penetration, and shall not support mold growth. Provide vapor barrier on all HVAC duct insulation, on except insulation for heating only.

2.03 BOILER STACKS AND BREECHING AND DIESEL ENGINE EXHAUST PIPING (D) INSULATION

A. ASTM C592 Class I or ASTM C612 Class 3 or ASTM C533, Type I. Insulation and minimum thickness shall comply with Table IV. Fill joints in the block insulation with mineral wool or equivalent insulation cement. For equipment operating at surface temperatures above 600 degrees F, apply block in double layer construction with staggered joints.

2.04 EQUIPMENT

A. Insulate all equipment and accessories as specified in Table III. In outside locations, provide insulation one inch thicker than specified. Increase the specified insulation thickness for equipment only where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Additional insulation is not required for factory insulated equipment.

2.05 ADHESIVES, SEALANTS, AND COATING COMPOUNDS

A. Adhesive for Securing Insulation to Metal Surfaces and Vapor Barrier Lap Adhesive (For Use in Building Interior Only): ASTM C916, Type I (an adhesive in which the vehicle is nonflammable in liquid (wet) state and which will pass the edge burning test), or Type II (An adhesive in which the vehicle is nonflammable in the liquid (wet) state and which will not pass the edge burning test).

B. Mineral Fiber Insulation Cement: ASTM C195, thermal conductivity 0.85 maximum at 200 degrees F mean when tested per ASTM C177.

C. Weatherproof Coating: For outside applications use a weatherproof coating recommended by the manufacturer of the insulation and jackets.

2.06 ACCESSORIES

A. Staples: ASTM A167, Type 304stainless steel outside clinch type.

B. Insulation Bands: 3/4 inch wide; 0.20-inch aluminum.

C. Bands for Metal Jackets: 3/8-inch minimum width; 0.020-inch aluminum.

D. Anchor Pins: Provide anchor pins and speed washers recommended by the insulation manufacturer.

E. Glass Cloth and Tape: Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be used.

F. Coal Tar Saturated Organic Felt: ASTM D227, minimum weight of 13 pounds per 100 square feet.

G. Wire: Soft annealed stainless steel, 0.047 inch nominal diameter.

PART 3 - EXECUTION

3.01 PREPARATION

A. Do not insulate materials until all system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Insulate return ducts, outside air intakes and supply ducts to the room outlets, flexible runouts, plenums, casings, mixing boxes, filter boxes, coils, fans, and the portion of air terminals not in the conditioned spaces. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handle, safety relief, etc. Allow adequate space for pipe expansion. Conditioned space shall be defined as an area, room or space normally occupied and being heated or cooled for human habitation by any equipment. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems. Extend all surface finishes to protect all surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping and ductwork. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:
   1. Exposed air conditioning supply and return ducts in air conditioned space that furnish conditioned air 24 hours each day of the cooling season.
   2. Exposed heating supply and return ducts in spaces that are heated 24 hours each day of the heating season.
   3. Fibrous glass ductwork.
   4. Factory preinsulated flexible ductwork.
   5. Factory insulated ductwork, plenums, casings, mixing boxes, filter boxes.
   6. Vibration isolating connections.
   7. Adjacent insulation.
   8. ASME stamps.

9. Fan name plates.
10. Access plates in fan housings.

3.02 PIPING INSULATION

A. Pipe Insulation (Except Unicellular Insulation): Installation of HVAC insulation including materials and workmanship shall be in accordance with the New York State Energy Conservation Construction Code, except as modified herein. Place sections of insulation around the pipe and joints tightly butted into place. The jacket laps shall be drawn tight and smooth. Secure jacket with fire resistant adhesive, factory applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on centers and l/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps. Apply staples to both edges of the butt strips. When a vapor barrier jacket is required, as indicated in TABLE I, or on the ends of sections of insulation that butt against flanges, unions, valves, and fittings, and joints, use a vapor barrier coating or manufacturer's weatherproof coating for outside service. Apply this vapor barrier coating at all longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend the patch not less than l-l/2 inches past the break in both directions. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating for outside service. Seal with a brush coat of the same coating. Do not use staples to secure jacket laps on pipes carrying fluid medium at temperatures below 35 degrees F. Where penetrating roofs, insulate piping to a point flush with the top of the flashing and seal with the vapor barrier coating. Butt tightly the exterior insulation to the top of the flashing and interior insulation. Extend the exterior metal jacket 2 inches down beyond the end of the insulation. Seal the flashing and counterflashing underneath with the vapor barrier coating. In cold water piping in high humidity areas, use cellular glass, or flexible unicellular insulation.

B. Flexible Unicellular Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90 degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral fiber insulation inserts and sheet metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of vinyl lacquer finish to flexible unicellular insulation in outside locations.

C. Hangers and Anchors: Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide MSS SP 58, Type 40 galvanized steel shields or MSS SP 58, Type 39 protection saddles conforming to MSS SP 69. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts

shall be of cellular glass (minimum 8 pcf), molded glass fiber (minimum 8 pcf), or other approved material of the same thickness as adjacent insulation. Inserts shall have sufficient compressive strength to adequately support the pipe without compressing the inserts to a thickness less than the adjacent insulation. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation with vapor barrier coating, or for exterior work, manufacturers recommended weatherproof coating, as applicable. Where protection saddles are used, fill all voids with the same insulation material as used on the adjacent pipe.

D. Sleeves and Wall Chases: Where penetrating interior walls, extend a metal jacket 2 inches out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2 inches beyond the interior surface of the wall.

E. Flanges, Unions, Valves and Fittings Insulation (Except Flexible Unicellular) for Hot Piping: Factory fabricated removable and reusable insulation covers may be used. For inside high temperature hot water systems, heating hot water, and steam and condensate return systems, place factory premolded, precut or field fabricated segmented insulation of the same thickness and conductivity as the adjoining pipe insulation around the flange, union, valve, and fitting abutting the adjoining pipe insulation. If nesting size insulation is used, overlap 2 inches or one pipe diameter whichever is larger. Use insulating cement to fill voids. Elbows insulated using segments shall have not less than three segments per elbow. Place and joint the segments with manufacturer's recommended water vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Upon completion of installation of insulation, apply two coats of lagging adhesive with glass tape embedded between coats. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. The total dry film thickness shall be not less than 1/16 inch. Where unions are indicated not to be insulated, taper the insulation to the union at a 45 degree angle. Coat the insulation and all-purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. The total dry film thickness shall be not less than 1/16 inch. At the option of the Contractor, factory premolded one piece PVC fitting covers may be used in lieu of two coats of adhesive with tape embedded between coats. Factory premolded field fabricated segment or blanket insert insulation shall be used under the fitting covers. Install factory premolded one piece PVC fitting covers over the insulation and secure by stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not use PVC fitting covers where exposed to the weather. Limit the use of PVC fitting covers to ambient temperatures below 150 degrees F.

F. Flanges, Unions, Valves, Anchors, Fittings for Cold Piping: Factory fabricated removable and reusable insulation covers may be used. For piping insulation inside the building that service chilled water supply and return, condenser water supply and return, refrigerant suction, and A/C condensate drains, coat pipe insulation ends with vapor barrier coating not more than six inches from each flange, union, valve, anchor or fitting. Place insulation of the same thickness and conductivity as the adjoining pipe insulation (either premolded or segmented) around the item, butting the adjoining pipe insulation. If nesting size insulation is used, overlap the insulation 2 inches or one pipe diameter. Use loose fill mineral wool or insulating cement to fill the voids. Elbows insulated using segments shall not have less than 3 segments per elbow. Insulation may be secured by wire or tape until finish coating is applied. Apply two coats of vapor barrier coating with glass tape embedded between coats. Overlap tape seams one inch. Extend the coating out onto the adjoining pipe insulation 2 inches. Where unions are shown not to be insulated, the insulation shall be tapered to the union at a 45 degree angle. Seal the insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to the pipe for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface. Insulate flexible connections at pumps and other equipment with unicellular plastic insulation, unless otherwise indicated. At the option of the Contractor, premolded, one piece polyvinyl chloride (PVC) fitting covers may be used in lieu of the embedded glass tape. Factory premolded insulation or field fabricated insulation segments shall be used under the fitting covers. Blanket inserts may be used. Secure the covers with adhesive and vapor barrier tape with a vapor resistance of maximum 0.05 perm per ASTM E96, or with tacks made for securing PVC covers. Then coat all tape seams and tacks with Type II vapor barrier coating. Do not use premolded PVC fitting covers where exposed to weather. Limit the use of PVC covers to not less than 35 degrees F medium temperatures and below 150 degrees F ambient temperatures.

G. Flanges, Unions, Valves, Fittings, and Accessories: Insulate and finish as specified for the applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by the insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than 1 inch and the adjoining metal jacket not less than 2 inches. Factory preformed metal jackets may be used in lieu of the above for hot service.

3.03 DUCTS (HVAC) INSULATION

A. Rigid Insulation: Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches on centers and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors. Each pin or anchor shall be

capable of supporting a 20 pound load. Cut off protruding ends of pins, after clips are sealed with coating compound for inside work or manufacturer's recommended weatherproof coating for outside work, and reinforced with open weave glass membrane.

B. Flexible Blanket Insulation: Apply insulation with all joints tightly butted. Secure insulation to ductwork with adhesive in 6 inch wide strips on 12 inch centers. Staple laps of jacket with outward clinching staples and seal with foil scrim kraft (FSK) tape. For ductwork over 24 inches on horizontal duct runs, provide pins, washers and clips. Use pins on sides of vertical ductwork being insulated. Space pins and clips on 18 inch centers and not more than 18 inches from duct corners. Carry insulation over standing seams and trapeze type hangers. Install speed washers with pins and pin trimmed to washer. Sagging of flexible duct insulation will not be permitted. Cut off protruding ends of pins after clips are secured and sealed with coating compound for inside work. For warm air ducts, overlap insulation not less than 2 inches at joints and secure the laps with outward clinch staples on 4 inch centers. In cold air ducts, vapor seal all joints and staple as specified.

C. Insulation Finishes and Joint Sealing: Fill all breaks, punctures, and voids with vapor barrier coating compound for inside work or manufacturers recommended weatherproof coating for outside service. Vapor seal all joints by embedding a single layer of 3 inch wide open weave glass membrane, 20 by 20 mesh maximum size between two 1/16 inch wet film thickness coats of vapor barrier coating compound. Draw glass fabric smooth and tight with a 1-1/2 inch overlap. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill voids in the insulation with vapor barrier coating. Brush a coat of vapor barrier coating where required on HVAC ducts. Provide vapor barrier jacket continuous across seams, reinforcing, and projections. Where height of projections is greater than insulation thickness, carry insulation and jacket over the projection. For joints for heating only systems, provide insulation with two coats of fire resistant adhesive with glass fabric 20 by 20 maximum size mesh embedded between coats.

D. Access Plates and Doors: On acoustically lined ducts, plenums, and casings, provide insulation on access plates and doors. On externally insulated ducts, plenums, and casings, provide insulation filled hollow steel panels and doors for access openings. Bevel insulation around access plates and doors.

3.04 BOILER STACKS, BREECHING, AND DIESEL ENGINE EXHAUST INSULATION

A. Inside Mechanical Room: Bevel insulation neatly around openings and provide sheet metal insulation stop strips around such openings. Apply a skim coat of hydraulic setting cement directly to the insulation. Apply a flooding coat of adhesive over the hydraulic setting cement, and while still wet, press a layer of glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat glass cloth with adhesive. When dry, apply a finish coat of adhesive at can

consistency so that when dry no glass weave shall be observed. Provide metal jackets for exhaust pipes that are located up to 7 feet above finished floor and that pass through occupied spaces outside the mechanical room. Apply metal jackets directly over insulation and secure with 3/4 inch wide metal bands spaced on 18 inch centers. Do not insulate name plates.

3.05 EQUIPMENT INSULATION

A. General Procedures: Apply equipment insulation suitable for temperature and service in rigid block or semi-rigid board or flexible form to fit as closely as possible to equipment. Groove or score insulation where necessary to fit the contours of equipment. Stagger end joints where possible. Bevel the edges of the insulation for cylindrical surfaces to provide tight joints. Join sections of cellular glass insulation with bedding compound. After the cellular glass insulation is in place on areas to be insulated, except where metal encased, fill joints, seams, chipped edges, or depressions with bedding compound to form a smooth surface. Fill mineral fiber joints with insulating cement conforming to ASTM C195. Bevel insulation around name plates, ASME Stamp, and access plates. For insulation on equipment that must be opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Protect exposed insulation corners with corner angles under wires and bands.

B. Pumps: Insulate pumps used for hot service with 2 inch thick rigid mineral fiber insulation and pumps used for chilled water and brine service with 2 inch thick flexible unicellular sheets as follows: Insulate pumps by forming a box around the pump housing, drive shaft, and piping. Apply insulation to inside surfaces of 20 gauge galvanized sheet metal boxes having openings for drive shaft and pipes. Construct the box by forming the bottom and sides using joints which do not leave raw ends of insulation exposed. Band bottom and sides to form a rigid housing that does not rest on the pump. Between top cover and sides, fit joints tightly forming a female shiplap joint on the side pieces and a male joint on the top cover to make the top cover removable. Secure insulation to the box with adhesive. Allow clearance for draining and adjustment of pump shaft seal.

3.06 PAINTING AND IDENTIFICATION

A. Paint in accordance with Section 09 91 00, "Painting". Piping identification shall be as specified in Section 23 05 53, “Identification of HVAC Piping and Equipment”.

3.07 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

TABLE I INSULATION MATERIAL FOR PIPING					
SERVICE	**MATERIAL**	**SPEC.**	**TYPE**	**CLASS**	**VAPOR BARRIER REQUIRED**
Chilled Water (Supply & Return) Piping	Cellular Glass	ASTM C552	II	2	No
	Flexible Unicellular	ASTM C534	I or II		No
	Mineral Fiber	ASTM C547		1	Yes
Refrigerant Suction Piping	Flexible Unicellular	ASTM C534	I or II		No
Heating Hot Water (Supply & Return)	Cellular Glass	ASTM C552	II		No
	Mineral Fiber	ASTM C547		1	No
*A/C Condensate Drain Located Inside Bldg.	Mineral Fiber	ASTM C547		1	Yes
	Cellular Glass	ASTM C552	II	2	No
	Flexible Unicellular	ASTM C534	I or II		No
Medium Temperature Hot Water, (251°F to 350°F) Steam Piping & Condensate Return	Mineral Fiber	ASTM C547		1	No
	Calcium Silicate	ASTM C533	I		No
	Cellular Glass	ASTM C534	I or II		No
High Temperature Hot Water and Steam (351°F to 700°F)	Mineral Fiber	ASTM C547		2	No
	Calcium Silicate	ASTM C533	I		
Steam (701°F to 1,200°F)	Mineral Fiber	ASTM C547		3	No
	Calcium Silicate	ASTM C533	I		
Brine Systems Cryogenics (Minus 30 to Zero)	Cellular Glass	ASTM C552	II	2	No
Brine Systems Cryogenics (Zero to 34)	Cellular Glass	ASTM C552	II	2	No
*NOTE: If there is no condensation condition existing, insulation is not required for CPVC or PVC piping.					

TABLE II PIPING INSULATION WALL THICKNESS						
SERVICE	**MATERIAL**	**TUBE AND PIPE SIZE (INCHES)**				
		1/4 - 3/4	**1 – 1-1/4**	**1-1/2 - 3**	**4 - 6**	**8+**
Chilled Water (Supply & Return) Piping	Mineral Fiber	1/2	1/2	1	1	1
	Cellular Glass	1/2	1/2	1	1	1
	Flexible Unicellular	1/2	1/2	1	1	1
A/C Condensate Drain Located Inside Bldg.	Mineral Fiber	1	1	1-1/2	1-1/2	1-1/2
	Cellular Glass	1	1	1-1/2	1-1/2	1-1/2
	Flexible Unicellular	1	1	1-1/2	1-1/2	1-1/2
Refrigerant Suction Piping	Flexible Unicellular	1-1/2	1-1/2	2	2	2
Heating Hot Water (Supply & Return)	Cellular Glass	1-1/2	1-1/2	2	2	2
	Mineral Fiber	1-1/2	1-1/2	2	2	2
Steam, and Condensate Return (201°F to 250°F)	Mineral Fiber	2-1/2	2-1/2	2-1/2	3	3
Medium Temperature Hot Water and Steam (251°F to 350°F)	Mineral Fiber	3	4	4-1/2	4-1/2	4-1/2
	Calcium Silicate	3	4	4-1/2	4-1/2	4-1/2
	Cellular Glass	3	4	4-1/2	4-1/2	4-1/2
High Temperature Water and Steam (351°F to 500°F)	Mineral Fiber	4-1/2	5	5	5	5
	Calcium Silicate	4-1/2	5	5	5	5
Steam (501°F to 700°F)	Mineral Fiber	4-1/2	5	5	5	5-1/2
	Calcium Silicate	4-1/2	5	5	5-1/2	6
Steam (701°F to 900°F)	Calcium Silicate	4-1/2	5-1/2	6-1/2	7	8
	Mineral Fiber	4-1/2	5	6	6-1/2	7

TABLE II-continued PIPING INSULATION WALL THICKNESS						
SERVICE	**MATERIAL**	**TUBE AND PIPE SIZE (INCHES)**				
		1/4 - 3/4	**1- 1-1/4**	**1-1/2 - 3**	**4 - 6**	**8+**
Steam (901°F to 1,200°F)	Mineral Fiber	6	7	8	9	10
	Calcium Silicate	5	6	7	9	10
Brine Systems Cryogenics (Minus 30 to Zero)	Cellular Glass	3	3	3	3-1/2	4
	Flexible Unicellular	1	1-1/4	1-1/4	1-1/2	1-1/2
Brine Systems, Cryogenics (Zero to 34)	Cellular Glass	2-1/2	2-1/2	2-1/2	3	3-1/2
	Flexible Unicellular	1	1	1	1-1/4	1-1/4
*NOTE: Insulation located outside shall be one inch thicker than that shown in table above.						

TABLE III INSULATION FOR EQUIPMENT				
MATERIAL	**SPEC**	**TYPE**	**CLASS**	**VAPOR BARRIER REQUIRED**
Flexible Mineral Fiber	ASTM C553	I	B-3	Yes*/No
Rigid Mineral Fiber or Cellular Glass	ASTM C612		2	Yes*/No
	ASTM C552	I		No
Flexible Unicellular	ASTM C534	II		No
*Yes for chilled water and brine service and no for other services.				

TABLE III EQUIPMENT TO BE INSULATED		
EQUIPMENT	**RECOMMENDED WALL THICKNESS**	**VAPOR BARRIER REQUIRED**
Heat Exchangers	2"	For Chilled Water and Brine Systems
Expansion Tanks	2"	For Chilled Water and Brine Systems
Air Separators	2"	For Chilled Water and Brine Systems
All Pumps	2"	For Chilled Water and Brine Systems
Hot Water Storage Tanks	2"	No
Hot Water Heat Exchangers or Steam to Hot Water Convectors Up to 249°F	2"	No
250°F to 400°F	3-1/2"	No
401°F to 600°F	6"	No
Hot Water Duct Mounted Coils	2"	No
Drain Pans	2"	For Chilled Water Systems
Buffer Water Tanks	2"	For Chilled Water Systems
Water Boxes and Headers	2"	For Chilled Water Systems
*Exact insulation thickness may be determined by proposed condition of use.		

TABLE IV INSULATION WALL THICKNESS (INCHES)						
SERVICE AND SURFACE TEMPERATURE RANGE	**MATERIAL**	**OUTSIDE DIAMETER (INCHES)**				
		1/4 - 1-1/4	**1-1/2 - 3**	**3-1/2 - 5**	**6 - 10**	**11 - 36**
Boiler Breech and Stack (Up to 400 Degrees F)	Mineral Fiber ASTM C553 Class B-3, ASTM C547 Class 1, or ASTM C612 Class 1	N/A	N/A	2	2	2
	Calcium Silicate ASTM C533 Type 1	N/A	N/A	2	2	2

END OF SECTION

SECTION 23 09 23

DIRECT DIGITAL CONTROL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Direct Digital Control Systems for a fully functional standalone DDC system to operate new HVAC equipment, as specified and/or directed.

B. Related work specified elsewhere:
   1. Section 23 05 00 – Mechanical General Requirements
   2. Section 23 21 23 – Hydronic Pumps
   3. Section 23 34 01 – HVAC Fans
   4. Section 23 52 16 – Condensing Boilers
   5. Section 23 74 16 – Packaged Rooftop Air Conditioning Unit

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
   1. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) Publication:
      a. 135 – BACnet Standard
   2. Electronic Industries Association (EIA) Publication:
      a. 709 – LonTalk Standard
   3. National Electrical Manufacturers Association (NEMA) Publication:
      a. 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
      b. DC-3 – Wall-Mounted Room Thermostats
   4. National Fire Protection Association (NFPA) Publication:
      a. 70 – National Electrical Code
      b. 90A – Installation of Air Conditioning and Ventilating Systems
   5. Underwriter's Laboratories Inc. (UL) Publicaiton:
      a. Fire Protection Equipment Directory
      b. 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors
      c. 916 – Energy Management Equipment
   6. Uniform Fire Prevention and Building Code of New York State Publication:
      a. 2020 – Mechanical Code
      b. 2020 –Energy Conservation Construction Code

1.03 DIRECT DIGITAL CONTROL (DDC) SYSTEMS:

A. Provide new complete standalone DDC Native BACNet-based system, web-based, including associated equipment, user interface, programming, software, hardware and appurtenances. Provide each system complete and ready for operation. Manufacturer's products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ANSI B31.1 and NFPA 70, except as modified herein or indicated otherwise. In ANSI B31.1 and NFPA 70, consider the advisory provisions mandatory. Substitute the word "shall" for "should" wherever it appears; interpret reference to the "Authority having jurisdiction" and "Owner" to mean the Engineer. Provide DDC systems to maintain the conditions indicated, to perform the functions indicated, and to operate in the sequence specified or indicated. Provide DDC systems with electric operators. Electric or electronic controllers may be used only for terminal unit controls. Control equipment, valves, panels, and dampers shall bear the manufacturer's nameplate and be BTL (BACnet Testing Laboratory) tested and listed. The DDC system shall be Trane Tracer SC+ with Tracer Synchrony user interface, or approved equal. Section 230501, “Mechanical General Requirements" applies to this section, with the additions and modifications specified herein.

1. Provide wiring and conduit required to connect control devices furnished as a part of the system. Control wiring is defined as wiring up to and including 120 volts. Install wiring in accordance with requirements of Division 26 and the National Electrical Code. Provide and install all required devices for proper system operation, including special electrical switches, transformers, relays, pushbutton stations, etc.

1.04 SUBMITTALS

A. Shop Drawings:

1. Temperature control system schematic, including required variables, flow diagrams, ladder diagrams, (I/O) list, and point to point wiring diagrams, indicating set points, reset ranges, throttling ranges, controller gains, differentials, operating ranges, normal positions, controller action, dial ranges, voltages, currents, mounting locations, indicators, and terminal strip points;
2. Sequence of operation for each system and function;
3. Generic, functional description of each control component indicated;
4. Equipment interlocks required by sequence of operation; and
5. Automatic valve schedule showing flow, C v, and pressure drop.

B. Manufacturer’s Data:

1. VAV box controls, valves and operators;
2. Boiler controls, valves, boiler pumps and sensors;
3. Input/output (I/O) modules, interface terminal, and controllers, including complete wiring and connection diagrams;
4. Temperature sensors, including complete wiring and connection diagrams;

5. Temperature and pressure indicators, including complete wiring and connection diagrams;
6. Pressure sensors, including complete wiring and connection diagrams;
7. Air flow monitoring stations;
8. Switches, relays, transmitters, transformers, including complete wiring and connection diagrams;

C. Certified Test Reports
1. Valve flow characteristics
2. Damper leakage rates
3. Inherent flow characteristics of each damper
4. Valve and damper operator power characteristics
5. Field acceptance report

D. Certificates of Compliance
1. Valves

E. Field Acceptance Inspections and Tests:
1. Includes check out and certification forms for all devices and systems.

1.05 QUALITY ASSURANCE

A. Contractor Experience and Qualifications:
1. The Contractor or subcontractor that will perform the work, with whom the Contractor has a firm contractual agreement, shall have completed at least three DDC systems installations of the same type and design specified, that have successfully operated for at least two years.

1.06 OPERATIONS AND MAINTENANCE MANUALS

A. Manuals shall include approved items of equipment and drawings provided under paragraphs titled "Shop Drawings" and "Manufacturer's Data" of this Section combined to provide a consolidated operation and maintenance manual. Manual shall contain full hardware support documentation, which shall include but not be limited to the following:
1. General description and specifications;
2. Installation and initial checkout procedures;
3. Detailed electrical and logical description;
4. Complete troubleshooting procedures, diagrams, and guidelines;
5. Complete alignment and calibration procedures for components;
6. Preventive maintenance requirements;
7. Detailed system schematics, system field assembly drawings, and system component specifications and dimensions;
8. Complete spare parts lists;
9. Interface requirements and capabilities;
10. Signal identification and timing diagrams; and
11. Complete as built control drawings, schedules, and sequence of operation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. System Components: The DDC System shall be comprised of high speed Ethernet network utilizing BACnet/IP communications between System Controllers and Workstations. Communications between System Controllers and sub-networks of Custom Application Controllers and/or Application Specific Controllers shall be defined below. Provide sensors compatible with the DDC equipment provided and with accuracies as stated herein. Coordinate instrument characteristics such as hysteresis, relaxation time, span, including maximum and minimum limits, for each application of the sensors and controls, so the control system operates smoothly and accurately throughout the design range. Each new DDC analog output shall have an actuator feedback signal, independent of control signal, wired, terminated and programmed in the control panel for true position information and troubleshooting.

1. Wireless Communication for use in HVAC Systems:
   a. Each building controller shall function as a BACnet Router to each unit controller providing a unique BACnet Device ID for all controllers within the system.
   b. Wireless equipment controllers and auxiliary control devices shall conform to IEEE 802.15.4 radios to minimize risk of interference and maximize battery life, reliability, and range.
   c. Operating range shall be a minimum of 200 feet (60 m); open range shall be 2,500 ft. (762 m) with less than 2% packet error rate.
   d. Wireless Communication Sensors for use in HVAC Systems:
      1) Wireless sensors shall be available as: temperature, relative humidity, CO2, and occupancy. All sensing types can be provided as individual devices or combined into a single device.
      2) The wireless communications sensor addresses shall be held in non-volatile memory to ensure operation through system voltage disturbances and to minimize the risk of incorrect association.
      3) To ensure proper system performance, the wireless communications sensor shall automatically determine when the space temperature is rapidly changing. When the space temperature is readily changing, the space temperature shall be transmitted at least once each 30 seconds. The maximum time between transmissions shall be 15 minutes.
      4) The wireless space sensor battery life shall provide at least 15 years life under normal operating conditions and must be readily available size AA, 1.5V.

5) The wireless communications sensors shall be addressed using pushbuttons and display with numerical indication to simplify and reduce installation time and minimize risk of incorrect addressing. Two position DIP switches are not acceptable.
6) Installation and replacement of failed sensors shall be accomplished without the use of proprietary tools.
7) The wireless communications sensors shall include security screws to protect against theft.
8) Operating & Storage range for: Temperature, Humidity Range, CO2 and Occupancy sensors.
   a) The ambient operating temperature range for the wireless communications sensor shall be 32° to 122°F (0° to 50°C).
   b) The ambient operating temperature range for the wireless communications sensor used for refrigerator/freezer monitoring shall be -25° to 122°F (-32° to 50°C).
   c) The ambient storage temperature range for the wireless communications sensor shall be -40° to 185°F (-40° to 85°C).
   d) The ambient operating and storage humidity range for the wireless communications sensor shall be 5% to 95%, non-condensing.
   e) The CO2 sensing range shall be 0 – 10,000 ppm, +/- 40 ppm.
   f) The Occupancy sensing range shall be 10 meters, 100 degree vertical coverage, 116 degree horizontal coverage.
   g) The Relative Humidity sensing accuracy shall be +/- 1.8%, +/- 1 % hysteresis.
9) Certifications: Wireless communications sensor component certifications shall include:
   a) TFP-13651127 - Canada Compliance
   b) UL 916 - Energy Management Equipment
   c) UL 94 - The Standard for Flammability of Plastic Materials for Parts in Devices and Appliances: 5 VA flammability rating
   d) UL 873 - Temperature regulating and indicating equipment.

2. The Controls Contractor shall provide all communication media, connectors, repeaters and network switches routers necessary for the high speed Ethernet communications network.

B. Operator Interface:

1. Enterprise Operator Web Interface, tie into existing Trane Controls Server.
    a. The Enterprise operator interface is a web-based, systems integration solution that gives facility managers an online, enterprise-wide view and control over of all their buildings and systems, from any device with a web browser on the network. (PC, laptop, tablet, smart phone).
    b. The system shall collect and display data from other systems via BACnet® IP, providing users the critical information needed to make enterprise-wide decisions for optimized performance.
    c. The Enterprise operator web interface shall be accessible via a web browser without requiring any "plug-ins" (i.e., JAVA Runtime Environment (JRE), Adobe Flash).
    d. The Enterprise operator interface software shall be installed on an existing local server provided by the building owner. The server hardware and any System level controllers are to reside on the building owner's network. (Note: The central server hardware, associated server operating system software, network cabling and switches is to be provided by others).
    e. Building Health Operator Interface View
        1) The Enterprise operator web interface shall provide a standard building health view that provides visual indication of which buildings have issues.
        2) The Enterprise operator web interface building health will display the summary information including number of active alarms for today, number of devices off-line, number or hot/cold spaces.
        3) The Enterprise operator web interface shall provide a direct link from any building health card to a building summary view that displays: active alarms for today, current chiller plant stats (if applicable), air handler status, and spaces that are too hot/cold.
        4) The Enterprise operator web interface shall provide the ability to group, filter, and sort the list of buildings.
        5) The Enterprise operator web interface shall allow a user to save filtering and grouping options as their default view.
        6) The Enterprise operator web interface shall allow a user to disable the building health display for any building.
    f. Customizable Navigation Tree
        1) The Enterprise operator web interface shall include a fully customizable navigation tree that shall allow an operator to do the following:
            a) Move and edit any of the nodes of the tree.
            b) Move entire groups to any area of the tree
            c) Change the name of any node in the tree

d) Create custom nodes for any page in the web interface including: graphics, data log views, schedules, and dashboards
e) Support navigation from multi-building to single building view
f) Provide the ability to assign graphics to any node in the tree
g) Ability to create folders and assign and change hierarchy of nodes of the tree

g. Mobile User Interface
1) The Enterprise operator mobile friendly pages will allow the operator to accomplish the following tasks:
a) System Status
b) Equipment status
c) Space Status
d) Standard Equipment graphics
e) Override editable points
f) Override occupancy
g) Acknowledge Alarms
h) Comment on Alarms
i) Delete Alarms
j) View, edit, and change schedules
k) Veiw mobile friendly dashboards
l) View custom graphics
m) Quickly change from mobile view to full desktop mode

h. Equipment & Application Pages
1) The Enterprise operator web interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:
a) Equipment Graphics for each major piece of equipment and floor plan in the System, including Air Handler and VAV Terminal. These graphics shall show all points dynamically as specified in the points list. Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.
b) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.

c) Historical Data (As defined in Data Log section below) for the equipment or application without requiring a user to navigate to a Data Log page and perform a filter.
d) View of all custom graphical programming for supported controllers in real time
e) View and management of all points for equipment and applications
f) Support documents that have been assigned for that equipment
g) Live data view for any selected points
h) Touch friendly design for all action buttons, navigation, and spacing

i. System Graphics. Enterprise operator web interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using colors to represent zone temperature relative to zone set point.
1) Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
2) Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
3) Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

j. Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.

k. Document Support. The Enterprise operator web interface shall support the ability to import support files into a support files library.
1) Imported support files can include the following types of document formats: pdf, docx, xlsx, pptx, jpeg, tif, bmp, png, jpg, gif.
2) All imported support files can be associated directly with equipment or family types that can then be accessed directly from standard pages.

l. Manual Control and Override.
   1) Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system.
   2) Timed Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
   3) Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.
   4) Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.
   5) Global Point Control. Provide a method for a user to view, override, and edit if applicable, the status of multiple object and properties in the system. The point status shall be available by menu, on graphics or through custom programs.
   6) Creating Override Search Queries. The system shall allow the operator to search for overrides across building(s), equipment, systems. User shall have the ability to view and release multiple overrides at once or one at a time.

m. Scheduling. A user shall be able to perform the following tasks utilizing the Enterprise operator web interface:
   1) Create a new schedule, defining the default values, events and membership.
   2) Create exceptions to a schedule for any given day.
   3) Apply an exception that spans a single day or multiple days.
   4) View a schedule by day, week and month.
   5) Exception schedules and holidays shall be shown clearly on the calendar.
   6) Modify the schedule events, members and exceptions.
   7) Create schedules and exceptions for multiple buildings
   8) Apply emergency schedule to multiple buildings
   9) Drag and drop scheduling editing
   10) Global schedule and exceptions across multiple buildings

n. Data Logs
   1) Enterprise operator web interface shall allow a user with the appropriate security permissions to define a Data Log for any data in the system.
   2) The Enterprise operator web interface shall allow a user to define any Data Log options as described in the Application and Control Software section.

3) The operator shall be able to specify the duration of historical data to view by scrolling, zooming, or selecting from a pull down list.
4) The system shall provide a graphical trace display of the associated time stamp and value for any selected point along the x-axis.
5) Operator will have the ability to show alarms and overrides on any data log view.
6) The Enterprise operator web interface shall allow a user to Print or download Data Log views in multiple formats including raw data (CSV, XLS) or image (PNG, JPG, PDF, SVG).

o. Alarm/Event Notification
1) An operator shall be notified of new alarms/events as they occur while navigating through any part of the system via an alarm icon.
2) The operator will have the option of selecting an audible alarm notification for all alarm classes they subscribe to.
3) The system operator will have the option of setting specific times and days that that they will receive alarm notifications.
4) Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any Enterprise operator web interface.
a) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 24 categories based on severity.
b) Alarm/event messages shall use full language, easily recognized descriptors.
c) An operator with the proper security level may acknowledge and clear alarms/events.
d) All alarms/events that have not been cleared by the operator shall be stored by the building controller.
e) The alarm/event log shall include a comment field for each alarm/event that allows a user to add specific comments associated with any alarm.
f) All alarm logs will provide both grouping multiple filter options for sorting and locating specific alarm or groups of alarms.
g) Alarm logs shall provide the ability to navigate directly to object with one click

5) Alarm Configuration
   a) The operator shall be able to configure any object in the system to generate an alarm when transitioning in and out of a normal state.
   b) The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.
   c) The operator shall be able to set up conditional alarm limits based on reference points.
   d) The operator shall be able to create queries to see current alarm properties across building(s), equipment, systems for any available point.
   e) The operator shall be able to run saved queries to see current alarm settings and modify and change them in mass.

p. User Change Log. The operator shall be able to view all logged user changes in the system from any Enterprise operator web interface.
   1) An operator shall be able to group user changes by: date, affected, date & affected, user, date & user, transaction type, date & transaction type, or sort only.
   2) The operator will have the option of additional filtering capability of: date, transaction, type, user, affected, and details that can be used individually or in conjunction with other filters.

q. Standard and Custom Reports
   1) The Enterprise operator web interface shall provide a reporting package that allows the operator to select reports to run.
   2) The Enterprise operator web interface shall provide the ability to schedule reports to run at specified intervals of time.
   3) The Enterprise operator web interface shall provide the ability to email schedule reports at specified intervals of time.
   4) The Enterprise operator web interface shall allow a user to create reports in either a pdf. or Excel format.
   5) Reports and logs shall be readily printed to the system printer.
   6) The Enterprise operator web interface shall provide the ability to create and modify both standard and custom reports.
   7) The following standard reports shall be available without requiring a user to manually design the report:
      a) All Points in Alarm Report: Provide an on demand report showing all current alarms.

b) All Points in Override Report: Provide an on demand report showing all overrides in effect.
c) Site Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
d) Air Handler Status Report: Current status and short historical operation of selected air handlers
e) Air System Status Report: Current status and short historical operation of selected VAS
f) Area Status Report: Current status and short historical operation of selected Area
g) Chiller Plant Status Report: Current status and short historical operation of selected chiller plant
h) Chiller Status (ASHRAE) Report: Standard points defined by ASHRAE 147-2013 for tracking and operation of air conditioning equipment
i) Schedules Report: List of all weekly events for all schedules in selected buildings
j) Space Comfort Analysis Report: List of spaces that meet selected criteria for potential comfort issues (temp variance, high, low, unoccupied)
k) Space List Report: Current status of multiple spaces in selected buildings
l) Space Status Report: Current status and short historical operation of selected spaces

8) The following custom report functionality shall be available without requiring a third party reporting tool:
a) Bar Chart: Create a bar chart for any data log or custom report equation in the system
b) Line Chart: Create a line chart for any data log or custom report equation in the system
c) Scatter Plot: Create a scatter plot for any data log or custom report equation in the system
d) Histogram: Create a Histogram for any data log, point, or custom report equation in the system
e) Pie Chart: Create a Pie chart for any data log, point, or custom report equation in the system
f) Single Values: Display single values from any point, data log, or equation on a custom report
g) Values Table: Display a formatted table for point values from any family type (spaces, air handlers, chillers, areas, air systems, chiller plants, or programmable controllers)
h) Data Log Table: Create a formatted table from selected data logs

i) User Change Log Table: Create a formatted table of user changes with date/time, user, what was changed, new/old value for any family type (spaces, air handlers, chillers, areas, air systems, chiller plants, or programmable controllers)
j) Text Box: Create a text boxes that can be placed and sized on any custom report
k) Image: Download and place images that can be placed and sized on any custom report
l) Size and position of ability of all items on a custom report
m) Both standard and custom page size capabilities
n) Save, edit, delete, and save as capability
o) Equation capability on data logs or points that can be used in custom reports (+, -, *, /)

r. Remote Access / Network Security – The project's Controls Contractor shall provide secure remote access to the Building Automation System (BAS).
1) Secure remote access to the BAS shall not require additional software to be installed on the client device (i.e. VPN client).
2) Secure remote access to the BAS shall not require ANY inbound ports on a firewall to be "exposed" or "forwarded".

s. System Security
1) User Profiles shall restrict the user to only the objects, applications, and system functions as assigned by the system administrator.
2) The system shall include pre-defined "roles" that allow a system administrator to quickly assign permissions to a user.
3) User logon/logoff attempts shall be recorded.
4) The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
5) The system shall support Active Directory for user set-up and management
6) The system shall track and record all user log-in activity and all changes done at the enterprise level including who made the change, when, what was changed, pervious value and new value.

t. On-Line Help and Training
1) Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
2) On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.

2. Building operator web interface Trane Controls
    a. The building operator web interface shall be accessible via a web browser without requiring any “plug-ins” (i.e. JAVA Runtime Environment (JRE), Adobe Flash).
    b. User Roles:
        1) The system shall include pre-defined “roles” that allow a system administrator to quickly assign permissions to a user.
        2) User logon/logoff attempts shall be recorded.
        3) The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.
    c. On-Line Help and Training
        1) Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
        2) On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.
    d. Equipment & Application Pages
        1) The building operator web interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:
            a) Equipment Graphics for each major piece of equipment and floor plan in the System, including Air Handler and VAV Terminal. These graphics shall show all points dynamically as specified in the points list. Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.
            b) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.
            c) Historical Data (As defined in Data Log section below) for the equipment or application without requiring a user to navigate to a Data Log page and perform a filter.
    e. System Graphics. Building operator web interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using colors to represent zone temperature relative to zone set point.

1) Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
2) Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
3) Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

f. Graphics Library. Furnish a library of standard HVAC equipment such as chillers, air handlers, terminals, fan coils, unit ventilators, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.

g. Mobile App Interface
1) The operator interface shall support system access on a mobile device via a mobile app to:
a) Alarm log
b) System Status
c) Equipment status
d) Space Status
e) Standard Equipment graphics
f) Override set points
g) Override occupancy
h) Acknowledge Alarms
i) Comment on Alarms

h. Manual Control and Override
1) Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system.
2) Timed Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
3) Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.
4) Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

i. Scheduling - The scheduling application shall provide graphical representation of the day, week, month and exception events.

j. Alarm/Event Notification
1) Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any Enterprise operator web interface.

a) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 24 categories based on severity.
b) Alarm/event messages shall use full language, easily recognized descriptors.

k. Reports and Logs
1) The building operator web interface shall provide a reporting package that allows the operator to select reports.
2) The building operator web interface shall provide the ability to schedule reports to run at specified intervals of time.
3) The following standard reports shall be available without requiring a user to manually configure the report:
a) All Points in Alarm Report: Provide an on demand report showing all current alarms.
b) All Points in Override Report: Provide an on demand report showing all overrides in effect.
c) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
d) Points report: Provide a report that lists the current value of all points
e) VAV Air System. An operator shall be able to view and control (where applicable) via the building operator web interface the System Mode, System Occupancy, Ventilation (Outdoor air flow) setpoint, Ventilation (Outdoor air flow) status, Air Handler Static pressure setpoint, Air Handler Static pressure status, Air Handler occupancy status, Air Handler Supply air cooling and heating set points, Air Handler minimum, maximum and nominal static pressure setpoints, VAV box minimum and maximum flow, VAV box drive open and close overrides, VAV box occupancy status, VAV box Airflow to space, Average space temperature, Minimum space temperature, and Maximum space temperature.

3. Wireless Zone Sensors - Refer to Wireless Communications specifications.

C. Controller Software
1. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the building operator interface.
a. VAV Air System Application

1) The BAS shall provide an Air Systems application program that coordinates air handlers (AHU Gravity Ventilators (GV), exhaust fans (EF), and Variable Air Volume Terminal equipment.
2) The Air Systems application shall perform the following functions:
    a) Startup and shutdown the air handler safely. Ensure the VAV boxes are open sufficiently when the air handler is running, to prevent damage to the ductwork and VAV boxes due to high air pressure.
    b) Fan Pressure Optimization (ASHRAE 90.1) - Minimize energy usage by controlling system static pressure to the lowest level while maintaining zone airflow requirements. System static pressure controlled to keep the "most open" zone damper between 65% and 75% open.
    c) During commissioning, and with the engineer/owner, the controls contractor shall confirm the performance of Fan Pressure Optimization by conducting a field functional test that demonstrates critical zone reset.
    d) Ventilation Optimization (ASHRAE 62) – properly ventilate all spaces while minimizing operating energy costs, using measured outdoor air flow. Dynamically calculate the system outdoor air requirement based on "real time" conditions in the spaces (i.e., number of occupants, CO2 levels, etc.) minimizing the amount of unconditioned outdoor air that must be brought into the building.
    e) Demand Controlled Ventilation – the active ventilation setpoint shall modulate between the occupied ventilation and occupied standby ventilation setpoint; Resetting the setpoint based on CO2 levels in the space.
3) The Air Systems application shall provide a user interface that includes status of current system operation with real time data of key operating parameters. Key operating parameters include:
    a) Duct Static Pressure
    b) Duct Static Optimization Setpoint
    c) Outdoor Airflow
    d) Ventilation Optimization Setpoint
    e) Duct Static Optimization Maximum VAV Damper/Source VAV Box
    f) Ventilation Optimization Maximum VAV Vent Ratio/Source VAV box

4) The Air Systems status screens shall explain what optimization calculations are occurring, critical parameters, and source equipment members. The optimization status, inputs, and results shall be displayed for VAV Ventilation Optimization (calculating proper outside air intake) and VAV Duct Static Pressure Optimization (calculating proper fan static pressure).

5) The Air Systems application shall provide a user interface that enables configuration changes made by swipe and type fields, selection list, and check box entry for feature definition:
   a) VAV Auxiliary Night Heat
   b) VAV Source Temperature Distribution
   c) Changeover System control
   d) Start/Stop Delay operation
   e) Enable/Disable Optimization Strategies (Duct Static Optimization and Ventilation Optimization)

6) The operation of VAV Terminal equipment members of the VAV Air System shall be selected by check box to optionally participate in the following functions:
   a) System calculations (min, max, average)
   b) Duct Pressure Optimization
   c) Ventilation Optimization
   d) Drive to Maximum Override
   e) Common Source Temperature
   f) Common Space

7) The Air Systems application vendor shall provide a published applications guide that details the air system application operation, configuration, setup, and troubleshooting. The applications guide documentation shall be maintained under version control, and updated by the manufacture to reflect most recent feature updates as made available. Contents of the guide shall include:
   a) Description of System Operation
   b) Required Components
   c) Sequences of Operation
   d) Installation
   e) Controller Setup
   f) Required Programming
   g) Commissioning
   h) Optimization Strategies
   i) Special Applications
   j) Troubleshooting

8) The Variable Air System application shall present in plain user language the current operation with source zone information and reset events.

b. The following is a list of key measurements required to be trended by the system.

1) Air Systems:

Air Handling Unit (VAV)	Discharge Air Temperature
	Discharge Air Temperature Setpoint Active
	Space Temperature Active
	Cooling Capacity Status
	Discharge Air Flow

Air Handling Unit (CV)	Discharge Air Temperature
	Space Temperature Active
	Space Temperature Setpoint Active
	Cooling Capacity Status
	Heating Capacity Primary Status
	Outdoor Air Damper Position

VAV Box	Discharge Air Temperature
	Space Temperature Active
	Space Temperature Setpoint Active
	Air Flow Setpoint Active
	Discharge Air Flow

Variable Air System	Duct Static Optimization Duct Static Setpoint
	Space Temperature Average
	Ventilation Optimization Air Setpoint
	Operating Mode
	Duct Pressure Optimization Maximum

2) Area Control

Variable Air System	Duct Static Optimization Duct Static Setpoint
	Space Temperature Average
	Ventilation Optimization Air Setpoint
	Operating Mode
	Duct Pressure Optimization Maximum

D. Building Controllers

1. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in Application and Control Software section.
   a. The controller shall provide a USB communications port for connection to a PC.

2. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
3. All System Controllers shall have a real time clock and shall be able to accept a BACnet time synchronization command for automatic time synchronization.
4. Data shall be shared between networked System Controllers.
5. Serviceability – The System Controller shall have a display on the main board that indicates the current operating mode of the controller.
6. BACnet Test Labs (BTL) Listing. Each System Controller shall be listed as a Building Controller (B-BC) by the BACnet Test Labs.
7. Remote Access / Network Security – Controls manufacture shall provide secure remote access to the Building Automation System (BAS).
    a. Secure remote access to the BAS shall be available anywhere, anytime, using a compatible client device (PC/tablet/phone).
    b. Secure remote access to the BAS shall be maintained by controls manufacturer.
    c. Secure remote access to the BAS shall not require additional software to be installed on the client device (i.e. VPN client).
    d. Secure remote access to the BAS shall not require ANY inbound ports on a firewall to be "exposed" or "forwarded".

E. Application-Specific Controllers
1. Application Specific Controllers (ASC) shall be microprocessor-based DDC controllers which, through hardware or firmware design, control specified equipment. They are not user programmable, but are customized for operation within the confines of the equipment they are designed to serve.
2. Zone Controllers are controllers that operate equipment that control the space temperature of single zone. Examples are controllers for VAV, Fan coil, Blower Coils, Unit Ventilators, Heat Pumps, and Water Source Heat Pumps.
3. Software
    a. To meet the sequence of operation for each zone control, the controller shall use programs developed and tested by the controller manufacturer that are either factory loaded or downloaded with service tool to the controller.
    b. Stand-Alone Operation: Each piece of equipment specified in section "A" shall be controlled by a single controller and provide stand-alone control in the event of communication failure. In case of communications failure stand-alone operation shall use default values or last values for remote sensors read over the network such as outdoor air temperature.
    c. For controlling ancillary devices and for flexibility to change the sequence of operation in the future, the controller shall be capable running custom programs written in a graphical programming language.

4. Environment: Controller hardware shall be suitable for the anticipated ambient conditions.
    a. Storage: -55° to 203° F (-48° to 95° C) and 5 to 95% Rh, non-condensing.
    b. Operating: -40° to 158° F (-40 to 70° C) and 5 to 95% Rh, non-condensing.
    c. Controllers used indoors shall be mounted in a NEMA 1 enclosure at a minimum.
    d. Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 type waterproof enclosures, and shall be rated for operation at -40° to 158° F.
5. Input/Output
    a. For flexibility in selection and replacement of valves, the controllers shall be capable of supporting all of the following valve control types 0-10VDC, 0-5VDC, 4-20mA, 24VAC floating point, 24VAC - 2 position (Normally Open or Normally Closed).
    b. For flexibility in selection and replacement of sensors, the controllers shall be capable of reading sensor input ranges of 0 to10V, 0 to 20mA, pulse counts, and 200 to 20Kohm.
    c. For flexibility in selection and replacement of binary devices, the controller shall support dry and wetted (24VAC) binary inputs.
    d. For flexibility in selection and replacement devices, the controller's shall have binary output which are able to drive at least 12VA each.
    e. For flexibility in selection and replacement of motors, the controller shall be capable of outputting 24VAC (binary output), DC voltage (0 to 10VDC minimum range) and PWM (in the 80 to 100 Hz range).
    f. For future needs, any I/O that is unused by functionality of equipment control shall be available to be used by custom program on the controller and by another controller on the network.
    g. For future expansion and flexibility, the controller shall have either on board or through expansion, 20 hardware input/output points. Expansion points must communicate with the controller via an internal communications bus. Expansion points must be capable of being mounted up to 650ft. (200 m) from the controller. Expansion points that require the BACnet network for communication with the controller are not allowed.
6. Serviceability: The controller shall provide the following in order to improve serviceability of the controller.
    a. Diagnostic LEDs shall indicate correct operation or failures/faults for all of the following: power, sensors, BACnet communications, and I/O communications bus.
    b. All binary output shall have LED's indicating the output state.
    c. All wiring connectors shall removable without the use of a tool.

d. Software service tool connection through all of the following methods: direct cable connection to the controller, connection through another controller on BACnet link and through the controller's zone sensor.
e. For safety purposes, the controller shall be capable of being powered by a portable computer for the purposes of configuration, programming, and testing programs so that this work can be accomplished with the power off to the equipment.
f. Capabilities to temporarily override of BACnet point values with built-in time expiration in the controller.
g. BACnet MAC Address shall be set using decimal (0-9) based rotary switches.
h. Configuration change shall not be made in a programming environment, but rather by a configuration page utilizing dropdown list, check boxes, and numeric boxes.
i. For ease of troubleshooting, the Controller shall support BACnet data trend logging.
1) With a minimum of 20,000 trending points total on controller
2) Trends shall be capable of being collected at a minimum sample rate of once every second.
3) Shall be capable of trending all BACnet points used by controller
4) Trends shall be capable of being scheduled or triggered

7. Software Retention: All Zone Controller operating parameters, setpoints, BIOS, and sequence of operation code must be stored in non-volatile memory in order to maintain such information for months without power.
8. Agency Approval: The controller shall have meet the Agency Compliance:
a. UL916 PAZX, Open Energy Management Equipment
b. UL94-5V, Flammability
c. FCC Part 15, Subpart B, Class B Limit

F. Input/Output Interface
1. Hardwired inputs and outputs may tie into the system through building, custom application, or ASCs.
2. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
3. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.

4. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.
5. Analog inputs shall allow the monitoring of low voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
6. Binary outputs shall provide for on/off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have status lights. Outputs shall be selectable for either normally open or normally closed operation.
7. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.
8. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

G. Auxiliary Control Devices:
   1. Wired Temperature Sensors
      a. Temperature sensors shall be RTD or thermistor.
      b. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 m (5 ft) in length per 1 m2 (10 ft2) of duct cross section.
      c. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
      d. Space sensors shall be equipped with setpoint adjustment, override switch, display, and/or communication port as shown on plans.
      e. Provide matched temperature sensors for differential temperature measurement.

2. Static Pressure Sensors
    a. Sensor shall have linear output signal. Zero and span shall be field-adjustable.
    b. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.
    c. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.
    d. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.
3. Carbon Dioxide Sensors
    a. Carbon Dioxide sensors shall measure CO2 in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.
4. Relays
    a. Control relays shall be UL listed plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
    b. Time delay relays shall be UL listed solidstate plug-in type with adjustable time delay. Delay shall be adjustable ±200% (minimum) from setpoint shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
5. Differential Pressure Type Switches (Air or Water Service)
    a. Shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as shown.
6. Wireless Communication Sensors - Refer to Wireless Communications specifications.

H. Wiring and Raceways
1. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of this specification.
2. All insulated wire to be copper conductors, UL labeled for 90°C (194°F) minimum service.

I. Electrical and Electronic Power Supply and Wiring: Provide meeting requirements of Division 26.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Perform installation under the supervision of competent technicians regularly employed in the installation of DDC systems. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation. Install devices in readily accessible locations. Provide wiring and conduit to connect the DDC components for a complete and operational DDC system in accordance with Division 26.

1. Sensors: Sensors required for mechanical equipment operation shall be factory installed and wired as specified in mechanical equipment specifications. BAS manufacturer shall be responsible for coordinating these control devices and ensuring the sequence of operations will be met. Installation and wiring shall be in accordance with the BAS manufacturer's recommendations and Division 26. Room sensors shall be installed on concealed junction boxes properly supported by the block wall framing. For installation in dry wall ceilings, the low voltage sensor wiring can be installed exposed and must meet applicable National and Local Electrical Codes and Division 26. All wires attached to wall mounted sensors shall be sealed off to prevent air from transmitting in the associated conduit and affecting the room sensor readings. Install outdoor air temperature sensors on north wall complete with sun shield at manufacturer's recommended location and coordinated with Engineer.
2. Indicators: Mount temperature and pressure indicators to allow readability when standing at floor level; provide remote indicators where necessary.
3. Software Programming: Provide programming for individual mechanical systems to achieve all aspects of the sequence of operation specified. It is the BAS manufacturer's responsibility to ensure all mechanical equipment functions and operates as specified in sequence of operations. Provide sufficient programming comments in controller application software to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.
4. BAS Operator's Interface: Provide color graphics for each piece of mechanical equipment depicting sufficient I/O to monitor and troubleshoot operation. Additionally, provide individual floor plans of the building allowing an operator to quickly view the overall floor plan area for any out of tolerance conditions that may need addressing. Operator color graphics shall include, Rooftop Units, VAV Terminal Boxes, etc. These standard graphics shall depict all points dynamically as specified in the points list and/or indicated in sequence of operation. Provide all the labor necessary to install, initialize, start up, and trouble-shoot all operator interface software and their functions as described in this section. This includes any operating system software, the operator interface data base, and any third party software installation and integration required for successful operation of the operator interface.

3.02 ADJUSTMENTS

A. Adjust controls and equipment to maintain the conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.03 FIELD QUALITY CONTROL

A. Ensure that tests are performed or supervised by competent employees of the DDC system installer or the DDC system manufacturer regularly employed in the testing and calibration of DDC systems. If the Engineer witnesses tests, such tests shall be subject to approval. If the Engineer does not witness tests, provide performance certification. Perform field inspection and tests as stated in approved inspections and test plan.
   1. Plan for Inspections and Tests: Furnish a written inspections and tests plan developed by the manufacturer of the DDC system at least 10 days prior to the field acceptance test date. The plan shall delineate the inspections and testing procedures required for all DDC components and systems to demonstrate compliance with the requirements specified in the paragraph titled "Field Acceptance Testing" of this section. Additionally, the test plan shall indicate how DDC system is to be tested, what variables will be monitored during test, names of individuals performing tests, and what criteria for acceptance should be used. Indicate how operation of HVAC system and DDC system in each seasonal condition will be simulated.
   2. Field Acceptance Testing: Upon completion of continuous HVAC and DDC systems operation and before final acceptance of work, test the temperature control systems in service with the heating, ventilating, and air conditioning systems to demonstrate compliance with contract requirements. Notify the Engineer a minimum of ten working days prior to the date testing is to commence. Test controls and systems through each cycle of operation, including simulation of each season insofar as possible. Test safety controls to demonstrate performance of required function. Adjust or repair defective or malfunctioning DDC equipment or replace with new equipment. Repeat tests to demonstrate compliance with contract requirements.

3.04 SEQUENCE OF OPERATION:

A. Split Air Handling (AHU-X)) Units:
   1. Space Temperature Requirements:
      a. Maintain space temperature at 75ºF (adj.) summer mode and 70ºF (adj.) winter mode in all zones during occupied hours. During unoccupied hours, space temperatures shall be maintained at 85ºF and 55ºF.

b. Cooling mode shall be enabled whenever the outdoor air temperature is greater than 55ºF, and the economizer is disabled or fully open, and the supply fan status is on, and the heating is not active.

c. Heating mode shall be enabled whenever the outdoor air temperature is less than 65ºF, and the supply fan status is on, and the cooling is not active.

2. Supply (Occupied/Unoccupied Schedule):

a. The supply fan shall run continuously to maintain space temperature setpoints during occupied hours.

b. During unoccupied hours, the supply fan shall run when required to maintain night setback zone temperature setpoints or if a definable number of unoccupied zones need heating or cooling. To prevent short cycling, the fans shall have a user definable (adj) minimum runtime.

c. Supply air duct static pressure control: The controller shall measure duct static pressure and modulate the supply fan VFD speed to maintain a duct static pressure setpoint. The speed shall not drop below 30% (adj). The static pressure setpoint shall be reset based on zone cooling requirements. The initial duct static pressure setpoint shall be 1.5 inches (adj). As cooling demand increases, the setpoint shall incrementally reset up to a maximum of 1.8 inches (adj). As cooling demand decreases, the setpoint shall incrementally reset down to a minimum of 1.3 inches (adj).

d. Building static pressure: The controller shall measure building static pressure and enable the relief fan on low speed to maintain a building static pressure setpoint of 0.05 inches (adj). During economizer mode, the relief fan shall be enabled on high speed to maintain building static pressure setpoint of 0.05 inches (adj).

3. Mixed Air Dampers, and Carbon Dioxide (CO2) Control:

a. Modulate outside, return air dampers and relief air gravity ventilator damper to admit the minimum outside air volume as scheduled.

b. The outside air damper and gravity ventilator damper shall close, and the return air damper shall open when the unit is off. During Optimal Start Up mode, the mixed air damper shall operate as described during occupied mode except that the outside air damper and gravity ventilator damper shall modulate to fully closed.

c. Minimum Outside Air Ventilation – Carbon Dioxide (CO2) Control: When in the occupied mode, the controller shall monitor return air CO2 levels. The controller shall take the highest return air CO2 levels and modulate the outside air dampers open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of 750 ppm (adj).

d. Cooling Control (Occupied/Unoccupied Schedule): The controller shall monitor the supply air temperature and shall maintain a supply air temperature setpoint reset based on zone cooling requirements. The initial supply air temperature setpoint shall be 58ºF (adj). As cooling demand increases, the setpoint shall incrementally reset down to a minimum of 55ºF (adj). As cooling demand decreases, the setpoint shall incrementally reset up to a maximum of 65ºF.

e. Control (Occupied/Unoccupied Schedule): The controller shall monitor the supply air temperature and shall maintain a supply air temperature setpoint reset based on zone heating requirements. The initial supply air temperature setpoint shall be 60ºF (adj). As heating demand increases, the setpoint shall incrementally reset up to a maximum of 65ºF (adj). As cooling demand decreases, the setpoint shall incrementally reset down to a minimum of 60ºF. The controller shall measure the supply air temperature and modulate the heating coil valve to maintain its heating setpoint, or when the freezestat is on.

4. Economizer Control:
   a. The controller shall measure the mixed air temperature and modulate the outside air damper, return air damper and gravity ventilator damper in sequence to maintain a setpoint 2ºF (adj) less than the supply air temperature setpoint. The outside air damper shall maintain a minimum adjustable position as scheduled whenever occupied. The controller shall monitor return air humidity and use as required for economizer control.
   b. The economizer shall be enabled whenever the outside air temperature is less than 65ºF (adj), and the outside air temperature is less than the return air temperature, and the supply fan status is on.
   c. The economizer shall close whenever the mixed air temperature drops from 40ºF to 35ºF (adj), or the freezestat is on, or on a loss of supply fan status.
5. Filters: A filter maintenance differential pressure switch shall generate an alarm when pressure exceeds its adjustable setpoint.
6. Alarms: Upon a freezing condition at the heating coil (37ºF, adj.) as sensed by a low temperature sensor, the unit shall be shut down. Any outside air damper will be placed in their normal closed positions and the heating hot water coil control valve shall modulate fully open. The system will then indicate that a freezestat event has occurred, and must be manually reset before the unit is restarted.
   a. If the DDC receives a fire alarm signal from the building fire alarm control panel, the DDC will stop all fan driven equipment under its control. Only after the fire event has been cleared at the FACP, will the system be able to restart all effected equipment.

b. Upon receiving a supply air smoke detector status, the unit shall shut down and generate an alarm.

c. Alarms shall also be generated when the supply fan is in failure, in hand or runtime exceeded mode (user definable limits adj), high supply air static pressure, low supply air static pressure, supply fan VFD fault, high building static pressure, low building static pressure, high or low supply air temperature, high zone or return air COx concentrations (greater than 1000 ppm adj), high or low mixed air temperature, and high or low return air temperature.

B. Variable Air Volume (VAV-X) Terminal Units:

1. During occupied mode, the units shall maintain 75ºF cooling setpoint and 70ºF heating setpoint. During unoccupied mode, the units shall maintain night setback setpoints at 85ºF cooling and 55ºF heating. Occupant shall be able to adjust zone temperature heating and cooling setpoints (where indicated) at the zone sensor. A timed local override control shall allow occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

2. Occupied Mode: Unit shall monitor the discharge air temperature and maintain zone setpoints by controlling the airflow during occupied mode. When the zone temperature is greater than its cooling setpoint, the zone damper shall modulate between minimum occupied airflow (adj) and maximum cooling airflow (adj) until the zone is satisfied. When the zone temperature setpoint is between cooling and heating setpoints, the zone damper shall maintain the minimum zone ventilation (adj). When the zone temperature is less than its heating setpoint, the controller shall modulate the hydronic heating coil control valve to maintain the zone temperature at its heating setpoint. Additionally, if warm air is available from the AHU, the zone damper shall modulate between the minimum occupied airflow (adj) and the maximum heating airflow (adj) until the zone is satisfied. The controller shall limit the heating coil if the discharge air temperature is more than 15ºF (adj) above the zone temperature setpoint.

3. Unoccupied Mode: Zone damper shall maintain minimum unoccupied airflow (adj). Unit shall monitor the discharge air temperature. When the zone temperature is greater than its unoccupied cooling setpoint, the zone damper shall modulate between the minimum unoccupied airflow (adj) and the maximum cooling airflow (adj) until the zone is satisfied. When zone temperature is less than the unoccupied heating setpoint, the controller shall modulate the hydronic heating coil control valve to maintain the zone temperature at the setpoint.

4. Alarms shall be generated upon a high or low discharge air temperature (greater than 120ºF or less than 40ºF) and high or low zone temperature.

3.05 INSTRUCTION OF OPERATING PERSONNEL

A. Upon completion of the work and at a time designated by the Engineer, furnish the services of a competent technician regularly employed by the temperature control manufacturer for the instruction of Owner personnel in the operation and maintenance of each DDC system. Provide hands on instruction using operating equipment provided. The period of instruction shall be for not less than 8 hours in two separate 4-hour training sessions.

END OF SECTION

SECTION 23 11 23

FUEL GAS PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Fuel Gas Piping, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Section 23 05 00 – Mechanical General Requirements
2. Section 23 52 16 – Condensing Boilers
3. Section 23 74 16 – Packaged Rooftop air Conditioning Unit

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
1. American Gas Association (AGA) Publication:
a. B109.1 – Diaphragm Type Gas Displacement Meters (500 Cubic Feet Per Hour Capacity and Under)
b. B109.2 – Diaphragm Type Gas Displacement Meters (Over 500 Cubic Feet Per Hour Capacity)
c. B109.3 – Rotary Type Gas Displacement Meters
2. American National Standards Institute, Inc. (ANSI) Publication:
a. A13.1 – Scheme for the Identification of Piping Systems
b. B1.1 – Unified Screw Threads
c. B1.20.1 – Pipe Threads, General Purpose (Inch)
d. B16.3 – Malleable Iron Threaded Fittings
e. B16.5 – Pipe Flanges and Flanged Fittings
f. B16.9 – Factory Made Wrought Steel Butt Welding Fittings
g. B16.11 – Forged Steel Fittings, Socket Welding and Threaded
h. B16.33 – Manually Operated Metallic Gas Valves for use in Gas Piping Systems up to 125 psig (Sizes 1/2 through 2)
i. B16.38 – Large Metallic Valves for Gas Distribution (Manually Operated, NPS 2-1/2 to 12, 125 psig Maximum)
j. B16.39 – Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
k. B16.40 – Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
l. B18.2.1 – Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws
m. B18.2.2 – Square and Hex Nuts (Inch Series)
n. B31.8 – Gas Transmission and Distribution Piping Systems
o. Z21.41 – Quick Disconnect Devices for Use with Gas Fuel

p. Z21.45 – Flexible Connectors of Other Than All Metal Construction for Gas Appliances
q. Z21.69 – Connectors for Movable Gas Appliances
r. Z21.70 – Earthquake Actuated Automatic Gas Shutoff Systems
s. Z535.1 – Safety Color Code

3. American Society for Testing and Materials (ASTM) Publication:
   a. A53 – Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
   b. A193 – Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
   c. A194 – Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
   d. D2513 – Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
   e. D2683 – Socket Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
4. American Society of Mechanical Engineers (ASME) Publication:
   a. BPVSEC8 – Boiler and Pressure Vessel Code, Division 1 Rules for Construction of Pressure Vessels
5. Code of Federal Regulations (CFR) Publication:
   a. 49 PT 192 – Transportation of Natural and Other Gas by Pipeline: Minimum Federal Supply Standards
   b. 49 PT 195 – Transportation of Hazardous Liquids by Pipeline
6. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publication:
   a. SP58 – Pipe Hangers and Supports Materials, Design, and Manufacture
   b. SP69 – Pipe Hangers and Supports Selection and Application
   c. SP89 – Pipe Hangers and Supports Fabrication and Installation Practices
7. Military Standard (MIL STD):
   a. 101 – Color Code for Pipelines and for Compressed Gas Cylinders
8. National Fire Protection Association (NFPA) Publication:
   a. 54 – National Fuel Gas Code
   b. 58 – Storage and Handling of Liquified Petroleum Gases
9. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 Fuel Gas Code

1.03 SUBMITTALS

A. Manufacturer's Catalog Data:
   1. Pipe and fittings
   2. Valve boxes
   3. Hangers and supports
   4. Pressure regulator
   5. Gas equipment connectors
   6. Valves

7. Warning tape
8. Risers
9. Transition fittings
10. Gas meter

B. Manufacturer's Instructions:
1. Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart.
a. PE pipe and fittings

C. Statements:
1. Submit a copy of a certified ANSI B31.8 qualification test report for each welder and welding operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder.
a. Welders' qualifications
b. PE welders' qualifications
c. Welders' identification symbols

D. Certificates of Compliance:
1. PE pipe and fittings
2. Transition fittings

1.04 QUALITY ASSURANCE

A. Welder's Qualifications: Comply with ANSI B31.8. The steel welder shall have a copy of a certified ANSI B31.8 qualification test report. The PE welder shall have a certificate from a PE pipe manufacturer's sponsored training course. Contractor shall also conduct a qualification test. Submit each welder's assigned number, letter, or symbol used to identify work of the welder. Affix symbols immediately upon completion of welds. Welders making defective welds after passing a qualification test shall be given a requalification test and, upon failing to pass this test, shall not be permitted to work this Contract.

B. PE Piping Installers' Qualifications: Prior to installation, Contractor shall have supervising and installing personnel trained by a PE pipe manufacturer's sponsored course of not less than one week duration, or present proof satisfactory to the Engineer that personnel are currently working in the installation of PE gas distribution lines.

C. Safety Standards: 49 CFR PT 192.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe ends during transportation or storage to minimize dirt and moisture entry. Do not subject to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Conform to NFPA 54, New York State Fuel Gas Code and with requirements specified herein. Supply piping to appliances or equipment shall be at least as large as the inlets thereof.

2.02 PIPE AND FITTINGS

A. Aboveground and Within Buildings and Vaults:
   1. Pipe: Black steel in accordance with ASTM A53, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.
   2. Threaded Fittings: ANSI B16.3, black malleable iron.
   3. Socket Welding Fittings: ANSI B16.11, forged steel.
   4. Butt Welding Fittings: ANSI B16.9, with backing rings of compatible material.
   5. Unions: ANSI B16.39, black malleable iron.
   6. Flanges and Flanged Fittings: ANSI B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVSEC8. Flange faces shall have integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

B. Valves, Aboveground:
   1. Shutoff Valves, Sizes Larger Than 2 Inches: Cast iron body plug valve in accordance with ANSI B16.38, non-lubricated, wedge mechanism or tapered lift plug, and flanged ends.
   2. Shutoff Valves, Sizes 2 Inches and Smaller: Bronze body ball valve in accordance with ANSI B16.33, full port pattern, reinforced PTFE seals, threaded ends, and PTFE seat.
   3. Pressure Regulator: Self-contained with spring loaded diaphragm pressure regulator, psig to inches water reduction, pressure operating range as required for the pressure reduction indicated, volume capacity not less than indicated, and threaded ends for sizes 2 inches and smaller, otherwise flanged.

C. Gas Equipment Connectors:
   1. Flexible Connectors: ANSI Z21.45.
   2. Quick Disconnect Couplings: ANSI Z21.41.
   3. Semi Rigid Tubing and Fittings: ANSI Z21.69.

D. Hangers and Supports:
   1. MSS SP58, as required by MSS SP69.

E. Welding Filler Metal:
   1. ANSI B31.8.

F. Pipe-Thread Tape:
   1. Anti-seize and sealant tape of polytetrafluoroethylene (PTFE).

G. Bolting (Bolts and Nuts):
   1. Stainless steel bolting; ASTM A193, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts shall conform with ANSI B18.2.1 and ANSI B18.2.2 with coarse threads conforming to ANSI B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt studs shall extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts shall have American Standard regular square or heavy hexagon heads; nuts shall be American Standard heavy semi-finished hexagonal.

H. Gaskets:
   1. Fluorinated elastomer, compatible with flange faces.

I. Identification for Aboveground Piping:
   1. ANSI A13.1 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1-1/2 inches in diameter with legends in depressed black filled characters.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install gas piping, appliances, and equipment in accordance with NFPA 54 and the New York State Fuel Gas Code.

B. Piping: Cut pipe to actual dimensions and assemble to prevent residual stress. Within buildings, run piping parallel to structure lines and conceal in finished spaces. Terminate each vertical supply pipe to burner or appliance with tee, nipple and cap to form a sediment trap. To supply multiple items of gas burning equipment, provide manifold with inlet connections at both ends.
   1. Cleanliness: Clean inside of pipe and fittings before installation. Blow lines clear using 80 to 100 psig clean dry compressed air. Rap steel lines sharply along entire pipe length before blowing clear. Cap or plug pipe ends to maintain cleanliness throughout installation.

2. Aboveground Steel Piping: Determine and establish measurements for piping at the job site and accurately cut pipe lengths accordingly. For 2 inch diameter and smaller, use threaded or socket welded joints. For 2-1/2 inch diameter and larger, use flanged or butt welded joints.
   a. Threaded Joints: Where possible, use pipe with factory cut threads, otherwise cut pipe ends square, remove fins and burrs, and cut taper pipe threads in accordance with ANSI B1.20.1. Provide threads smooth, clean, and full cut. Apply anti seize paste or tape to male threads portion. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed. Use unions for connections to valves for which a means of disconnection is not otherwise provided.
   b. Welded Joints: Weld by the shielded metal arc process, using covered electrodes and in accordance with procedures established and qualified in accordance with ANSI B31.8.
   c. Flanged Joints: Use flanged joints for connecting welded joint pipe and fittings to valves to provide for disconnection. Install joints so that flange faces bear uniformly on gaskets. Engage bolts so that there is complete threading through the nuts and tighten so that bolts are uniformly stressed and equally torqued.
   d. Pipe Size Changes: Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted.
   e. Painting: Paint new ferrous metal piping, including supports, in accordance with Section 09 91 00, "Painting". Do not apply paint until piping tests have been completed.
   f. Identification of Piping: Identify piping above ground in accordance with ANSI A13.1, using adhesive backed or snap on plastic labels and arrows. Apply labels or tags to finished paint at intervals of not more than 50 feet. Provide two copies of the piping identification code framed under glass and install where directed.

C. Valves: Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally.

D. Pipe Sleeves:
   1. Where piping penetrates concrete or masonry wall, floor or firewall, provide pipe sleeve poured or grouted in place. Make sleeve of steel or cast iron pipe of such size to provide 1/4 inch or more annular clearance around pipe. Extend sleeve through wall or slab and terminate flush with both surfaces. Pack annular space with oakum, and caulk at ends with silicone construction sealant.

E. Piping Hangers and Supports:
   1. Selection, fabrication, and installation of piping hangers and supports shall conform with MSS SP 69 and MSS SP 89, unless otherwise indicated.

F. Final Connections:
   1. Make final connections to equipment and appliances using rigid pipe and fittings, except for the following:

3.02 FIELD QUALITY CONTROL

A. Metal Welding Inspection: Inspect for compliance with NFPA 54. Replace, repair, and then reinspect defective welds.

B. PE Fusion Welding Inspection: Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect 100 percent of all joints and reinspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the Engineer to make first time inspection.

3.03 TESTING

A. Pressure Tests: Use test pressure of 1-1/2 times maximum working pressure, but in no case less than 50 psig. Do not test until every joint has set and cooled at least 8 hours at temperatures above 50 degrees F. Conduct testing before backfilling; however, place sufficient backfill material between fittings to hold pipe in place during tests. Test system gas tight in accordance with NFPA 54, and the New York State Fuel Gas Code. Use clean dry air or inert gas, such as nitrogen or carbon dioxide, for testing. Systems which may be contaminated by gas shall first be purged as specified. Make tests on entire system or on sections that can be isolated by valves. After pressurization, isolate entire piping system from sources of air during test period. Maintain test pressure for at least 8 hours between times of first and last reading of pressure and temperature. Take first reading at least one hour after test pressure has been applied. Do not take test readings during rapid weather changes. Provide temperature same as actual trench conditions. There shall be no reduction in the applied test pressure other than that due to a change in ambient temperature. Allow for ambient temperature change in accordance with the relationship PF + 14.7 = (P1 + 14.7) (T2 + 460) / T1 + 460), in which "T" and "PF" represent Fahrenheit temperature and gauge pressure, respectively, subscripts "1" and "2" denote initial and final readings, and "PF" is the calculated final pressure. If "PF" exceeds the measured final pressure (final gauge reading) by 1/2 psi or more, isolate sections of the piping system, retest each section individually, and apply a solution of warm soapy water to joints of each section for which a reduction in pressure occurs after allowing for ambient temperature change. Repair leaking joints and repeat test until no reduction in pressure occurs. In performing tests, use a test gauge calibrated in one psi increments and readable to 1/2 psi.

B. System Purging: After completing pressure tests, and before testing a gas contaminated line, purge line with nitrogen at junction with main line to remove all air and gas. Clear completed line by attaching a test pilot fixture at capped stub in line at building location and let gas flow until test pilot ignites. Procedures shall conform to NFPA 54, and the New York State Fuel Gas Code.

CAUTION

Failure to purge may result in explosion
within line when air to gas is at correct mixture.

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING AND SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Hydronic Piping and Specialties as shown on the Plans, as specified, and/or directed.

B. Related work specified elsewhere:
1. Section 23 05 00 – Mechanical General Requirements
2. Section 23 05 53 – Identification for HVAC Piping and Equipment
3. Section 23 05 93 – Testing and Balancing Air and Water Systems
4. Section 23 07 00 – HVAC Insulation
5. Section 23 21 23 – Hydronic Pumps
6. Section 23 52 16 – Condensing Boilers

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
1. American National Standards Institute, Inc. (ANSI) Publication:
a. B1.1 – Unified Screw Threads
b. B2.1 – Pipe Threads (Except Dryseal)
c. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, 25, 125, 250, and 800 pound
d. B16.3 – Malleable Iron Threaded Fittings
e. B16.5 – Pipe Flanges and Flanged Fittings
f. B16.9 – Factory Made Wrought Steel Butt Welding Fittings
g. B16.11 – Forged Steel Fittings, Socket Welding and Threaded
h. B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings
i. B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
j. B16.24 – Bronze Pipe Flanges and Flanged Fittings
k. B16.39 – Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
l. B18.2.2 – Square and Hex Nuts (Inch Series)
m. B31.1 – Power Piping
n. B40.100 – Pressure Gauges and Gauge Attachments
o. B40.200 – Thermometers, Direct Reading and Remote Reading
p. Z49.1 – Safety in Welding and Cutting
2. American Society for Testing and Materials (ASTM) Publication:
a. A47 – Malleable Iron Castings
b. A53 – Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless

c. A120 – Pipe, Steel, Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless for Ordinary Uses
d. A183 – Heat Treated Carbon Steel Track Bolts and Carbon Steel Nuts
e. A194/A194M – Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
f. A307 – Carbon Steel Externally and Internally Threaded Standard Fasteners
g. A386 – Zinc Coating (Hot Dip) on Assembled Steel Products
h. A525 – Sheet Steel, Zinc-Coated (Galvanized) by the Hot-Dip Process
i. A536 – Ductile Iron Castings
j. B32 – Solder Metal
k. B75 – Seamless Copper Tube
l. B88 – Seamless Copper Water Tube
m. B111 – Copper and Copper Alloy Seamless Condenser Tubes and Ferrule Stock
n. B395 – U Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
o. D2000 – Rubber Products in Automotive Applications

3. American Society of Mechanical Engineers (ASME) Publication:
   a. BPV – Boiler and Pressure Vessel Code and Interpretations
   b. BPVSEC4 – Heating Boilers
   c. BPVSEC8 – Pressure Vessels (Division 1)
   d. PTC4.1 – Steam Generating Units
4. Copper Development Association, Inc. (CDA) Publication:
   a. 404/1 – Copper Tube Handbook
5. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publications:
   a. SP58 – Pipe Hangers and Supports Materials, Design, and Manufacture
   b. SP67 – Butterfly Valves
   c. SP69 – Pipe Hangers and Supports Selection and Application
   d. SP70 – Cast Iron Gate Valves, Flanged and Threaded Ends
   e. SP80 – Bronze Gate, Globe, Angle and Check Valves
   f. SP83 – Carbon Steel Pipe Unions Socket Welding and Threaded
6. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 Mechanical Code

1.03 SUBMITTALS

A. Detail Drawings: Shop Drawings and Catalog Cuts: Submit shop drawings and catalog information showing plan, elevations, dimensions, capacities, and ratings for the following:
   1. Piping and fittings
   2. Valves

3. Hangers and Supports
4. Expansion tank(s)
5. Flow meter
6. Air separating tank
7. Flexible connectors

B. Certificates of Compliance:
1. Manufacturer's Certificate: Submit manufacturer's certificate of boiler performance and a Certificate of Full Approval or a current Certificate of Approval for backflow preventers.

C. Welding Submittals: As required by ANSI B31.9 and ANSI B31.5.

1.04 GENERAL REQUIREMENTS

A. Classes and Maximum Working Pressures: Except as specified otherwise, equipment and piping components shall be suitable for use under the maximum working pressures indicated. Except as modified herein, the pressure temperature limitations shall be as specified in the referenced standards and specifications. All pressures in this specification are pressures in pounds per square inch (psi) above atmospheric pressure, and all temperatures are in degrees Fahrenheit (F).

B. Safety Standards:
1. Welding: Safety in welding and cutting of pipe shall conform to ANSI Z49.1.
2. Guards: Couplings, motor shafts, gears and other moving parts shall be fully guarded, in accordance with OSHA 29 CFR 1910.219. Guards shall be cast iron or expanded metal. Guard parts shall be rigid and suitably secured and be readily removable without disassembling the guarded unit.

1.05 WELDING REQUIREMENTS

A. Welding Procedure: Before any welding is performed, the Contractor shall submit to the Owner's Representative three copies of welding procedure specification for all metals included in the work, together with proof of its qualifications in accordance with ANSI B31.9 and ANSI B31.5.

B. Performance Qualification Record: Before any welder or operator performs any welding, the Contractor shall also submit to the Owner's Representative three copies of the Welder's Performance Qualification Record in conformance with ANSI B31.9 and ANSI B31.5 showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition, the Contractor shall submit the assigned number, letter, or symbol used to identify the work of the welder, and affix it immediately upon completion of the weld. Give welders making defective welds, after passing a qualification test, a requalification test, and do not permit them to work under this Contract if they fail the requalification test.

C. Previous Qualifications: Welding procedures, welders, and welding operators previously qualified by test may be accepted for this Contract without requalifying subject to the approval of the Owner's Representative and provided that all the conditions specified in ANSI B31.9 and ANSI B31.5 are met before a procedure is used.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Low Pressure Piping System: Requirements specified herein working pressure of 30 psi or less.
   1. Hot Water Heating and Condensate Drain Pipe (Supply and Return): ASTM B88 Type L Copper tubing.

B. Fittings: Fittings shall be comparable thickness with the pipe being used, and shall conform to the following requirements.
   1. Fittings for Copper Tubing 2-1/2 Inches and Smaller: ANSI B16.18 cast bronze solder joint type or ANSI B16.22 wrought copper solder joint type. Fittings may also be flared or compression joint type.

C. End Connections:
   1. Copper Tubing:
      a. ASTM B32, Grade Sb5, tin-antimony alloy. Soldering flux shall consist of petrolatum base impregnated with zinc and ammonium chlorides.

D. Unions:
   1. Copper Tubing: ANSI B16.18 solder joint end.
   2. Dielectric Union: Insulated union provided with a galvanized steel female pipe threaded end and a copper solder joint end conforming with FS WW U 531, Class 1, dimensional, strength and pressure requirements. Union shall have a water impervious insulation barrier capable of limiting galvanic current to one percent of the short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600 volt breakdown test.

E. Flanges: Removed raised faces when used with flanges having a flat face.
   1. Cast Iron Screwed Flanges: ANSI B16.1.
   2. Bronze Screwed Flanges: ANSI B16.24.

F. Flexible Connectors:
   1. Class 150, flexible metal connector, stainless steel annular hose with stainless steel braid. End fittings shall be ANSI Class 150 raised face carbon steel flanges. Inner convoluted hose shall be Type 304 stainless steel and exterior sleeve shall be braided Type 304 stainless steel. Nominal pipe size 1-1/2” to 5” shall have minimum overall length of 12”.

Nominal pipe size 6” to 10” shall have minimum overall length of 18”. Nominal pipe size over 12” shall have minimum overall length of 24”. Minimum rated pressure shall be 150 PSIG, provide double braided hose as required to achieve pressure rating. Maximum lateral offset shall be no less than 1/4". Manufacture shall be as by Mason Industries, or approved equal.

G. Instrumentation:

1. Pressure and Vacuum Gauges: ANSI B40.100 with restrictor, located as indicated. Furnish pressure gauges with black phenol cases constructed of glass filled polypropylene. Gauge face shall have a diameter of 4-1/2 inches. Gauges shall be stem mounted with phosphor bronze bourdon tubes. Manufacture shall be as by Ashcroft (Model 1279), or approved equal. Furnish with 1/4 turn, ball type bronze isolation valve and pigtail siphon. Pressure range shall be 0-150 psig.
2. Indicating Thermometers: ANSI B40.200, liquid-in-glass red or blue column, clear plastic window, with 6-inch brass stem, vertical scale immersion type furnished with brass well, adjustable angle, scale not less than 9 inches with a range of 30ºF to 240ºF for hot water systems and 20ºF to 180ºF for chilled or condenser water systems. Temperature ranges to be approved prior to order or installation. Manufacture shall be as by Weksler Instruments, or approved equal.
3. Thermowell: ANSI B40.200, reduced tip stainless steel thermowells to accept the temperature sensing devices. Immersion length shall be as required and connections shall be 3/4-inch NPT. Manufacture shall be as by Weksler Instruments, Ashcroft, or approved equal.

H. Miscellaneous Pipeline Components:

1. Air Vent: Float type to vent air in hydronic systems. Vent to be constructed of noncorrosive materials and to have NPT male inlet and compression connector for 1/4 inch overflow for safe water connection.
2. Strainers (2 Inches and Smaller): Strainers shall be Y-pattern type, bronze body, screwed, Class 150, with 20 mesh Monel screen. Provide all strainers with bronze blow-down valve. Manufacture shall be as by Watts, Nibco, or approved equal.
3. Strainers (2-1/2 Inches and Larger): Strainers shall be Y-pattern type, cast iron body, flanged, Class 250 with 20 mesh Monel screen. Provide all strainers with bronze blow-down valve. Manufacture shall be as by Watts, Nibco, or approved equal.
4. Basket Strainers: Strainers shall be the ANSI 125 pound, iron body flanged basket type, self-cleaning with angular cutaway brass basket (60 mesh), and large open area to minimize pressure loss. Manufacture shall be as by Watts, Keckley, Eaton, or approved equal.

2.02 VALVES

A. Valves shall have rising stems and shall open when turned counterclockwise.

B. Gate Valves:
   1. Bronze Gate Valves: Two inches and smaller. Wedge disc, rising stem, inside screw type not less than 150-pound class. Use solder joint ends with copper tubing conforming to ANSI B16.18.
   2. Cast Iron Gate Valves: 2 1/2 inches and larger. ASTM A125, Class B cast iron, flanged, Class 150, OS&Y with rising stem, bolted bonnet and ASTM B62 bronze disc and seat.

C. Ball Valves:
   1. Ball Valves: Three inches and smaller. 600 psi CWP, cast bronze bodies, Class 150, two-position hand levers, full port, replaceable reinforced Teflon seats, blow-out proof stem with chrome-plated ball and threaded ends. Manufacture shall be as by Nibco, Apollo, or approved equal.

D. Globe and Angle Valves:
   1. Bronze Globe and Angle Valves: 2 inches and smaller. ASTM B62 bronze, screwed, Class 150, union bonnet, with renewable ASTM A276, Type 420 stainless steel seat and disc and threaded ends. Manufacture shall be as by Nibco, Powell, or approved equal.
   2. Cast Iron Globe and Angle Valves: 2 1/2 inches and larger. ASTM A125, Class B cast iron, flanged, Class 150, with bronze trim, tapped drains and brass plug. Manufacture shall be as by Nibco, Powell, or approved equal.

E. Check Valves:
   1. Check Valve 2-1/2 Inches and Smaller: Swing type check valves shall be ASTM B62 bronze body, threaded, Class 125, threaded cap with bronze trim. Manufacture shall be as by Nibco, Watts, or approved equal.
   2. Check Valve 3-Inches and Larger: Swing type check valves shall be ASTM A-126, Class B cast iron body flanged, Class 150, bolted cap with bronze trim. Manufacture shall be as by Nibco, Watts, or approved equal.
   3. Disc Check Valve: Dual disc type, spring actuated with grooved end ductile iron body, bronze discs, stainless steel stem and springs, and resilient disc seats. Disc check valves shall be as manufactured by Victaulic Series 711, or equal.
   4. Wafer Check Split Disc Valves: Valves shall be high-performance, dual plate, flat seat and independent springs. Body shall be cast iron with aluminum bronze discs, Buna N seals, wafer body suitable for mounting between ANSI 125 pound flanges. Manufacture shall be as by Flomatic (Model 895), Crane, or approved equal.

F. Flow Control Valves:

1. Flow control valves for low temperature hot water heating systems, shall be specially designed check valves with bronze body and trim, which shall open by the pressure developed by the pump, and close automatically. Provide means to hold the valve in the open position when the system is to be drained.

G. Butterfly Valves:

1. Butterfly Valves (2 Inches and Larger): The valves shall conform with MSS SP67, Type I Tight shut off valve, and valve ends shall be Flanged. The valve body material shall be bronze and shall be bubble tight for shutoff at 150 psig. Flanged and flangeless type valves shall have Type 300 series corrosion resistant steel stems and corrosion resistant or bronze discs with molded elastomer disc seals. Flow conditions shall be for the regulation from maximum flow to complete shutoff by way of throttling effect. Valves shall be used in closed open system. Valves smaller than 8 inches shall have throttling handles. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and indicators. Valves shall have a minimum of 7 locking positions and shall be suitable for water temperatures up to 200ºF. Manufacture shall be as by Nibco, Watts, Anvil, or approved equal.

H. Balancing Valves:

1. Balancing Valves (3 Inches and Smaller): Brass construction with 304 stainless steel ball, Teflon seats and two (2) ¼-inch differential pressure read-out ports. Valves shall be provided with calibrated nameplates and memory stops. Valves shall be manufactured by Bell & Gossett Circuit Setter Plus, or approved equal.
2. Balancing Valves (4 Inches and Larger): Cast iron, flanged rated for 175 psig working pressure, or ductile iron grooved, rated for 300 psig, multi-turn globe style, brass disc, EPDM soft seat, and two pressure/temperature ports. Valve shall utilize a calibrated nameplate with position indicator from 0 to 100% open and memory button. Valves shall be manufactured by Bell & Gossett Circuit Setter Plus, or approved equal.

I. Triple-Duty Valves:

1. Straight or angle pattern, threaded cast-iron or bronze valve body with built-on bonnet for 175 psig operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation. Manufacture shall be as by Bell and Gossett, or approved equal.

J. Condenser Water Control Valves:

1. Provide direct acting pressure actuated modulating valves as scheduled for connection to the water cooled condensing units and regulating cooling tower water flow. Furnish valve with 6 foot capillary tube with an operating range of 70 psig to 260 psig. Valve shall be spring actuated with adjusting screw and NPT or flanged valve connections as indicated. Valve shall be as manufactured by Penn, Series V46.

K. Pressure Reducing Valves (Chilled Water and Condenser Water Systems):

1. Valves shall be designed to maintain a constant downstream pressure at varying inlet pressures. The valves shall be hydraulically operated, diaphragm actuated, globe pattern valve. Main valve body and cover shall be cast iron with ANSI 125 pound flanged ends and bronze trim. The pilot control shall be a direct-acting, adjustable, spring-loaded, normally open diaphragm valve, designed to permit flow when controlled pressure is less than the spring setting. Furnish with dual strainers with isolation valves. Set pressure range shall be adjustable from 15 to 75 psig, sizes as shown. Manufacture shall be as by Cla-Val Co. (90 G), Flowmatic Series (C100), or equal.

L. Pressure Relief Valve:

1. Valve shall be diaphragm assist-operated bronze body ASME Safety Relief Valve. Inlet size shall be 3/4-inch with a relief setting of 30 psig. Manufacture shall be as by Bell and Gossett (Model 790-75), or equal.

2.03 FLOW METERS

A. Provide a calibrated flow indicating fitting in each temperature control circuit. Fitting shall be suitable for operation at a maximum pressure of 100 psig and a maximum water temperature of 250 degrees F. Each fitting shall have the provision for connecting a portable differential pressure meter used to determine circuit flow rates in GPM. Provide a portable meter for use with all new flow fittings.

2.04 EXPANSION TANKS

A. Expansion tank to be welded steel, and constructed and tested hydrostatically in accordance with ASME BPVSEC8 of the Boiler Pressure Vessel Code. The design working pressure of the tank shall be either the head imposed on it by the system or 150 psig, whichever is greater. Zinc coat the tank inside and out after fabrication by the hot dip process ASTM A386. Tank shall have drain, fill, air charging and system connections, automatic makeup, and automatic relief to drain with air gap between relief outlet and drain. Tank shall be pneumatically pressurized during charging of water, so that the system is fully charged with the water, and with level in the expansion tank at normal level and at normal operating conditions. Manufacture shall be as by Bell & Gossett, Taco, or approved equal.

2.05 EXTERNAL AIR SEPARATION TANK

A. External air separation tank shall be of steel, designed for not less than 75 psig and constructed and tested in accordance with ASME BPVSEC8 of the Boiler and Pressure Vessel Code. The capacity of the separator shall not be less than indicated. Tank shall have tangential connections, flanged for sizes 2-1/2 inches and larger. Each unit shall have an internal design suitable for creating the required vortex and subsequent air separation, for air release to the system compression tank, and shall also have a galvanized steel strainer. A blow down connection shall be provided with a gate valve blow down connection piped to nearest floor drain. Manufacture shall be as by Bell & Gossett, Taco, or approved equal.

2.06 PIPE, VALVES AND EQUIPMENT INSULATION

A. Section 23 07 00, “HVAC Insulation”.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Piping: Unless specifically stated to the contrary, fabrication, assembly, welding, soldering, and brazing shall conform to ANSI B31.1 for all piping of the hot water system and ANSI B31.9 for chilled and condenser water systems. Provide drain valves at low points of piping system, and air vent valves at high points where air pockets would occur. All piping shall follow the general arrangement shown; cut accurately to measurements established for the work by the Contractor, and work into place without springing or forcing, except where cold springing is specified. Install piping and equipment within buildings entirely out of the way of lighting fixtures and doors, windows, and other openings. Run overhead piping in buildings in the most inconspicuous positions. Provide adequate clearances from walls, ceilings, and floors to permit the welding of joints; at least 6 inches for pipe sizes 4 inches and less, 10 inches for pipe sizes over 4 inches, and in corners provide sufficient clearance to permit the welder to work between the pipe and one wall. Make provision for expansion and contraction of pipelines. Make changes in size of waterlines with reducing fittings. Do not bury, conceal, or insulate piping until it has been inspected, tested, and approved. Protect materials and equipment from the weather. Do not run piping concealed in walls or partitions or underground or under the floor except as otherwise indicated. Where pipe passes through building structure, do not conceal pipe joints but locate where they may be readily inspected. Run all pipe to be insulated as shown and as required with sufficient clearance to permit application of insulation. Use flanged joints only where necessary for normal maintenance and where required to match valves and equipment. Provide gaskets, packing, and thread compounds suitable

for the service. Use long radius ells wherever possible to reduce pressure drops. Pipe bends in lieu of welding fittings may be used where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and must be free from any appreciable flattening, wrinkling, or thinning of the pipe. Do not use mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction. Make all branch connections with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ANSI B31.1 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run. Run all piping essentially as indicated, taking care to avoid interference with other piping, conduit, or equipment. Except where specifically shown otherwise, vertical piping shall run plumb and straight and parallel to walls. Trapping of lines is not permitted except as otherwise indicated. Provide sleeves of suitable size for all lines passing through building structure. Install piping connected to equipment to provide flexibility for thermal stresses and for vibration, and adequately support and anchor so that strain from weight and thermal movement of piping is not imposed on the equipment.

1. Welding:
    a. Welding Procedure Specifications: Before any welding is performed, the Contractor shall submit three copies of his welding procedure specification for all metals included in the work, together with proof of its qualification as outlined in ANSI B31.1.
    b. Performance Qualification Record: Before any welder or operator performs any welding, submit three copies of Welder's Performance Qualification Record in conformance with ANSI B31.1 showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition, submit each welder's assigned number, letter, or symbol used to identify the work of the welder, and affix immediately upon completion of the weld. To welders making defective welds after passing a qualification test give a requalification test and upon failing to pass the test do not permit to work this contract.
    c. Previous Qualifications: Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without requalification subject to the approval and provided that all the conditions specified in ANSI B31.1 are met before a procedure can be used.
2. Brazing and Soldering:
    a. Brazing and Soldering Procedure Qualifications: Brazing and soldering procedure qualifications shall conform to ANSI B31.1. Brazing procedure for joints shall be as outlined in CDA 404/1, the Copper Tube Handbook, published by the Copper Development Association.

b. Soldering Preparation and Procedures: Soldering, soldering preparation, and procedures for joints shall be in accordance with ANSI B31.1 and as outlined in CDA 404/1, the Copper Tube Handbook, published by the Copper Development Association.

3. Hangers and Supports: The design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP58 and ANSI B31.1. Hanger types and supports for bare and covered pipe shall conform to MSS SP69 for the temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP58. Continuous inserts and expansion bolts may be used.
   a. Maximum Spacing Between Supports:
      1) Vertical Piping: Support metal piping at not more than 10-foot intervals.
      2) Horizontal Piping: Support cast-iron piping at 5-foot intervals, except for pipe exceeding 5-foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support piping and copper tubing as follows, unless indicated otherwise:

MAXIMUM SPACING (FEET)						
Nominal Pipe Size (Inches)	One and Under	1.25	1.5	2	2.5	3 and Over
Steel Pipe	7	8	9	10	11	12
Copper Tube	6	6	7	7	8	8

4. Grading of Pipelines: Unless otherwise indicated, install horizontal lines of hot water piping to grade down in the direction of flow with a pitch of not less than one inch in 30 feet, except in loop mains and main headers where the flow may be in either direction.

5. Pipe Sleeves: Provide sleeves where pipes and tubing pass through masonry or concrete walls, floors, roof, and partitions. Sleeves in outside walls below and above grade, in floor, or in roof slabs, shall be steel pipe. Sleeves in partitions shall be zinc coated sheet steel having a nominal weight of not less than 0.906 pound per square foot. Space between pipe, tubing, or insulation and the sleeve shall be not less than 1/4 inch. Hold sleeves securely in proper position and location before and during construction. All sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 2 inches above the finished floor. Firmly pack space between the pipe or tubing and the sleeve with oakum and calk on both ends of the sleeve with elastic cement.

6. Floor, Wall, and Ceiling Escutcheon Plates: Secure sleeves in buildings other than power and heating plants, to the pipe. Plates on pipes passing through floors and partitions of toilet rooms shall be chromium plated steel or nickel plated cast iron; all other plates shall be painted cast iron, malleable iron, or steel.
7. Flashing for Buildings: Provide flashing where pipes pass through building roofs, and make outside walls tight and waterproof.
8. Unions and Flanges: Provide unions and flanges where necessary to permit easy disconnection of piping and apparatus and as indicated. Each connection having a screwed end valve shall have a union. Place unions and flanges as indicated. Use unions on piping under 2 inches in diameter, and use flanges on piping 2 inches and over in diameter. Provide dielectric unions or flanges between ferrous and nonferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous to ferrous or nonferrous to nonferrous connections. Dielectric fittings shall utilize a nonmetallic filler which will prevent current flow from exceeding one percent of the short circuit current. The spacer shall be suitable for the pressure and temperature of the service. . Flanges and unions shall conform to the requirements of ANSI B16.10.
9. Changes in Pipe Size: Use reducing fittings for changes in pipe size; the use of bushings is not to be permitted. In horizontal lines, use reducing fittings of the eccentric type to maintain the top of the lines in the same plane.
10. Cleaning of Pipe: Thoroughly clean each section of pipe, fittings, and valves positively free of all foreign matter before erection. Prior to erection, hold each piece of pipe in an inclined position and thoroughly tap along its full length to loosen sand, mill scale and other foreign matter. Pipe 2 inches and larger shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to apparatus, wash out the interior of all piping thoroughly with water. Plug or cap open ends of mains during all shutdown periods. Do not leave lines open at any place where any foreign matter might accidentally enter pipe.

B. Valves:
1. General: Install valves in conformance with ANSI B31.1, ASME BPVSEC4 of the Boiler and Pressure Vessel Code, and as required herein at the locations indicated and elsewhere as required for the proper functioning of the system. Remove valve bonnets, where valve construction permits removal, when connecting valves by brazing to copper tubing. Install all valves with stems horizontal or above. Provide unions on one side of all valves to facilitate servicing. Locate or equip stop valves to permit operation from floor level, or provide with safe access in the form of walkways or ladders. Install valves in positions accessible for operation and repair.

2. Globe Valves: Install globe valves so that the pressure is below the disk and the stem horizontal.

C. Pressure Gage: Provide a shut off valve or pet cock between pressure gages and the line.

D. Thermometers: Provide thermometers and thermal sensing elements of control valves, etc., with a separable socket. Install separable sockets in pipelines in such a manner to sense the flowing temperature of the fluid and minimize obstruction to flow.

E. Strainers: Provide strainers with meshes suitable for the services where indicated, or where dirt might interfere with the proper operation of valve parts, orifices, or moving parts of equipment.

F. Connections to Existing Services: Provide connections, splices, and branches at the locations shown. When new fittings are installed into an existing pipeline for the purpose of a branch or splice, the new fittings shall be of the same diameter as the existing pipeline. New branch lines off existing pipelines may be of reduced diameter.

3.02 CLEANING, PAINTING AND IDENTIFICATION

A. Clean and paint piping in accordance with Section 09 91 00, “Painting”.

B. Exposed piping shall be painted for the purpose of color coding in accordance with the identification code currently in use. Identify all piping in accordance with Section 23 05 53,”Identification for HVAC Piping and Equipment”.

3.03 TESTING

A. General: The Contractor is responsible for the performance of all inspections and tests as specified herein to demonstrate that the piping system, as installed, is in compliance with contract requirements. During testing, clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water occurs when strainers are cleaned. In accordance with the General Provisions, the Owner will furnish water and electricity.

B. Piping System: Test piping system hydrostatically using water not exceeding 100ºF. Conduct tests in accordance with the requirements of ANSI B31.1 and as follows. Test the piping system after the lines have been cleaned as herein specified and before insulation covering has been applied. Tests piping systems at a pressure of 30 psig. In all tests remove or valve off from the system, gages, and other apparatus which maybe damaged by the test before the tests are made. Repair leaks. Do not caulk joints. Install calibrated test pressure gage in the

system to observe any loss in pressure. Maintain the required test pressure for a sufficient length of time to enable an inspection to be made of all joints and connections. Perform tests after installation and prior to acceptance.

END OF SECTION

SECTION 23 21 23

HYDRONIC PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Hydronic Pumps as shown on the Plans, as specified, and/or directed.

B. Related work specified elsewhere:
1. Section 23 05 00 – Mechanical General Requirements
2. Section 23 05 53 – Identification for HVAC Piping and Equipment
3. Section 23 05 93 – Testing and Balancing Air and Water Systems
4. Section 23 07 00 – HVAC Insulation
5. Section 23 09 23 – Direct Digital Control Systems
6. Section 23 52 16 – Condensing Boilers

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
1. American National Standards Institute, Inc. (ANSI) Publication:
a. B1.1 – Unified Screw Threads
b. B2.1 – Pipe Threads (Except Dryseal)
c. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, 25, 125, 250, and 800 pound
d. B16.3 – Malleable Iron Threaded Fittings
e. B16.5 – Pipe Flanges and Flanged Fittings
f. B16.9 – Factory Made Wrought Steel Butt Welding Fittings
g. B16.11 – Forged Steel Fittings, Socket Welding and Threaded
h. B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings
i. B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
j. B16.24 – Bronze Pipe Flanges and Flanged Fittings
k. B18.2.2 – Square and Hex Nuts (Inch Series)
l. B31.1 – Power Piping
m. B40.100 – Pressure Gauges and Gauge Attachments
n. B40.200 – Thermometers, Direct Reading and Remote Reading
2. American Society for Testing and Materials (ASTM) Publications:
a. A47 – Malleable Iron Castings
b. A53 – Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
c. A120 – Pipe, Steel, Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless for Ordinary Uses
d. A183 – Heat Treated Carbon Steel Track Bolts and Carbon Steel Nuts

e. A194/A194M – Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
f. A307 – Carbon Steel Externally and Internally Threaded Standard Fasteners
g. A386 – Zinc Coating (Hot Dip) on Assembled Steel Products
h. A525 – Sheet Steel, Zinc-Coated (Galvanized) by the Hot-Dip Process
i. A536 – Ductile Iron Castings
j. B32 – Solder Metal
k. B75 – Seamless Copper Tube
l. B88 – Seamless Copper Water Tube
m. B111 – Copper and Copper Alloy Seamless Condenser Tubes and Ferrule Stock
n. B395 – U Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
o. D2000 – Rubber Products in Automotive Applications

3. American Society of Mechanical Engineers (ASME) Publications:
   a. BPV – Boiler and Pressure Vessel Code and Interpretations
   b. BPVSEC4 – Heating Boilers
   c. BPVSEC8 – Pressure Vessels (Division 1)
   d. PTC4.1 – Steam Generating Units
4. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publications:
   a. SP58 – Pipe Hangers and Supports Materials, Design, and Manufacture
   b. SP67 – Butterfly Valves
   c. SP69 – Pipe Hangers and Supports Selection and Application
   d. SP70 – Cast Iron Gate Valves, Flanged and Threaded Ends
   e. SP80 – Bronze Gate, Globe, Angle and Check Valves
   f. SP83 – Carbon Steel Pipe Unions Socket Welding and Threaded
5. Uniform Fire Prevention and Building Code of New York State Publications:
   a. 2020 Energy Conservation Construction Code
   b. 2020 Mechanical Code

1.03 SUBMITTALS

A. Detail Drawings: Shop Drawings and Catalog Cuts: Submit shop drawings and catalog information showing plan, elevations, dimensions, capacities, and ratings for the following:
   1. Pump(s)
   2. Pump Accessories
   3. Hangers and Supports

B. Certificates of Compliance:
   1. Manufacturer's Certificate: Submit manufacturer's certificate of boiler performance and a Certificate of Full Approval or a current Certificate of Approval for backflow preventers.

1.04 GENERAL REQUIREMENTS

A. General Requirements: General requirements include those specified in Section 23 05 00, "Mechanical General Requirements", and the additional requirements specified herein below.

B. Classes and Maximum Working Pressures: Except as specified otherwise, equipment and piping components shall be suitable for use under the maximum working pressures indicated. Except as modified herein, the pressure temperature limitations shall be as specified in the referenced standards and specifications. All pressures in this specification are pressures in pounds per square inch (psi) above atmospheric pressure, and all temperatures are in degrees Fahrenheit (F).

C. Safety Standards:
   1. Guards: Couplings, motor shafts, gears and other moving parts shall be fully guarded, in accordance with OSHA 29 CFR 1910.219. Guards shall be cast iron or expanded metal. Guard parts shall be rigid and suitably secured and be readily removable without disassembling the guarded unit.

PART 2 - PRODUCTS

2.01 MATERIALS

2.02 GENERAL

A. Furnish centrifugal pumps and accessories, designed for use in the indicated environments and of the arrangement, configuration and performance specified and indicated in this Specification and as scheduled.
   1. Nameplate: Provide unit nameplate with, at a minimum, manufacturer's name, address, design data, model number and serial number. The nameplate must be securely affixed in a conspicuous place.
   2. Coating: All ferrous surfaces are to be primed and painted with an industrial grade oil based alkyd primer and oil based enamel topcoat, after surfaces have been prepared by removing all rust and contaminants.

2.03 CAPACITY/PERFORMANCE

A. Unit shall be designed specifically for use in the intended application, with stable operation across entire specified operating range. Scheduled performance is the performance required under specified or indicated installation conditions with specified or indicated accessories. Proposed equipment shall be rated under these

conditions. Unit shall be capable of achieving the scheduled values indicated in the Pump Schedule on the Contract Documents. Ensure pump operation at specified system fluid temperatures without vapor binding and cavitation. Motors shall be selected to be non-overloading at all potential operating points and shall operate to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the Engineer.

1. NPSH: The pump NPSH shall confirm to the ANSI/HI 9.6.1-1997 standards for Centrifugal and Vertical Pumps for NPSH Margin.
2. Vibration: The pump vibration limits shall conform to Hydraulic Institute ANSI/HI 9.6.4-2009 for recommend acceptable unfiltered field vibration limits (as measured per ANSI/HI 9.6.4-2009 Figure 9.6.4.2.3.1) for pumps with rolling contact bearings.
3. Seismic: The seismic capability of the pump shall allow it to withstand a horizontal load of 0.5g, excluding piping and/or fasteners used to anchor the pump to mounting pads or to the floor, without adversely affecting pump operation.
4. Motors: Shall meet scheduled horsepower, speed, voltage and enclosure design. Pump and motors shall be factory aligned and shall be realigned after installation by the manufacturer's representative. Motors shall be non-overloading at any point on the pump curve. Motors shall meet NEMA Premium™ efficiency electric motor specifications.
5. Inverter Duty Motor Requirements: For each motor that will be operated by a variable frequency drive (VFD), the following requirements also apply. Motors shall be squirrel cage induction motors specifically designed, manufactured and tested for use on VFDs. These motors shall provide for constant torque or variable torque applications over a specific speed range when operated from a VFD. The motor shall be designed, constructed, and tested in accordance with all applicable requirements of the latest standards of IEEE, NEMA, ANSI, and with the requirements of the National Electrical Code. The nameplate shall clearly state that the motor is designed for inverter duty application.
    a. The winding insulation system shall be rated Class F. System components such as slot liners, wedges, and phase separators shall be Class F or class H and the whole insulation system shall be of non-hygroscopic materials. Inter-phase insulation paper shall be used. Triple coat magnet wire or advanced design magnet wire shall be used. Wound stators with insulating materials in position shall be oven baked to drive-off residual moisture, then dipped in Class H varnish and baked again to cure the varnish. A minimum of two dip and bake cycles is required. The full load temperature rise (of the windings) when the motor is operated on sine wave power shall be measured by resistance and shall be within Class B allowable limits. The entire insulation system shall be capable of withstanding the 1600V spikes experienced with dV/dt IGBT waveforms as defined in NEMA MG1, Part 31. Motor bearings

shall be insulated or isolated. All leads shall be copper stranded wire of the appropriate gauge for the motor rating. The stator windings shall be 100% copper. There shall be no copper to aluminum connections within the motor. Motor shall be rated for 1.0 service factor when operated on non-sinusoidal power. Temperature rise (measured by resistance) shall not exceed Class F limits when operated on non-sinusoidal power.

2.04 CLOSE-COUPLED INLINE PUMPS

A. Pumps shall be horizontal installation type for standard operation at 250° F and 175 psig maximum pressure, single stage, closed coupled, in cast iron bronze fitted construction. Cast iron casing with integral flanged pump connections, stainless steel impeller keyed to shaft with stainless steel split cone and nut, and high temperature bellows and seal assembly, EPR/Carbon/Silicon carbide seal faces mounted in stainless steel components. Motor shall be non-overloading, NEMA rated, with horsepower, speed, voltage and enclosure as scheduled. Performance and electrical characteristics as scheduled. Selected catalog data submitted for approval shall include pump speed and characteristic curve for performance of impeller selected for each pump. Curves shall indicate capacity vs head, efficiency, and brake horsepower for full range, from shut off to free delivery. Manufacture shall be as by Bell & Gossett Series e-90, or approved equal.

2.05 PUMP CONTROLS

A. Controls for pumps shall be as specified in Section 23 09 23, “Direct Digital Controls”.

2.06 INSULATION

A. Section 23 07 00, “HVAC Insulation”.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Rigging, erection, installation and start-up assistance of the pump equipment and accessory systems shall be conducted in complete accordance with the manufacturer’s recommended procedures, all applicable local, State and Federal codes, and as specified herein.

B. Coordination of Work: The Contract Drawings indicate a diagrammatic arrangement of the intended equipment systems. The Contractor shall use the Contract Drawings as a guide for the final installations, following the indicated arrangements as closely as is practicable. Maximize headroom and access space

around all equipment components and provide neat and concise piping and equipment arrangements. Provide adequate access to all pumps, controls, equipment and other devices requiring maintenance and manual operation.

C. The Contractor shall provide all labor, materials, equipment, supervision, and specialties necessary to accomplish the installation of the new pumps and associated accessories. Install and locate all pumps and accessory equipment in accordance with the Contract Drawings. All work shall be performed by skilled professional tradesman under the direction of experienced supervisors and the manufacturer's representative. Minor alternations revisions shall be brought to the attention of the Engineer for approval prior to the commencement of such work. Pumps and other equipment components shall be handled with care during transport and rigging so as to prevent damage to those items of equipment.

D. Install pumps strictly in accordance with installation instructions of the manufacturers. Install pumps in such a manner as not to place a strain on any of the equipment and piping.

3.02 CLEANING OF SYSTEMS

A. As installation of the various system components is completed, adequately clean each before final closing. Remove all foreign matter from equipment and surrounding areas. Preliminary or final tests are not permitted until the cleaning is approved.

3.03 TESTING AND COMMISSIONING

A. General: The Contractor is responsible for the performance of all inspections and tests as specified herein to demonstrate that the pumps, as installed, are in compliance with contract requirements. Start up and initially operate the system with all components operating. During this time, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. During start up and during the tests, factory trained engineers or technicians employed by individual suppliers shall be present as required, to insure the proper functioning, adjustment, and testing of the individual components and systems. Contractor shall furnish all labor, equipment, glycol, water, and test apparatus.

B. Pump Tests: Observe and check all pumps and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctions, defects, noncompliance with referenced standards, or overloading, as applicable. Correct any defects, leaks or malfunctions and retest for full compliance.

3.04 INSTRUCTION OF OPERATING PERSONNEL

A. Upon completion of the work, and acceptance of the installation, and at a time designated by the Owner, the services of a competent technician regularly employed or authorized by the manufacturer of the pumps shall be provided for instructing personnel in the proper operation, maintenance, safety and emergency procedures. The period of instruction shall be not less than two hours. The training shall be conducted at the job site during actual operation and coordinated with the Owner one week in advance.

END OF SECTION

SECTION 23 31 13

DUCTWORK AND DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Ductwork and Ductwork Accessories, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Division 1 – General Requirements
2. Section 23 05 00 – General Mechanical Requirements
3. Section 23 05 53 – Identification for HVAC Piping and Equipment
4. Section 23 05 93 – Testing and Balancing Air and Water Systems
5. Section 23 07 00 – HVAC Insulation
6. Section 23 37 13 – Diffusers, Registers and Grilles

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
1. Air Diffusion Control (ADC) Publication:
a. 1062-R4 – Certification, Rating and Test Manual
b. AD – Measurement of Room to Room Sound Transmissions Through Plenum Air Systems
2. Air Movement and Control Association, Inc. (AMCA) Publication:
a. 500 – Test Methods for Louvers, Dampers and Shutters
3. American Society for Testing and Materials (ASTM) Publication:
a. A123 – Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
b. A167 – Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strip
c. A653 – Steel Sheet, Zinc-Iron Alloy coated (Galvanized) by the Hot Dip Process
d. B117 – Salt Spray (Fog) Testing
e. B127 – Nickel Copper Alloy (UNS N04400) Plate, Sheet, and Strip
f. B209 – Aluminum and Aluminum-Alloy Sheet and Plate
g. C423 – Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
h. C553 – Mineral Fiber Blanket and Felt Insulation (Industrial Type)
i. D822 – Operating Light and Water Exposure Apparatus (Carbon Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products

j. D1654 – Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
k. E84 – Test Method for Surface Burning Characteristics of Building Materials
l. E90 – Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
m. E96 – Water Vapor Transmission of Materials

4. National Fire Protection Association (NFPA) Publication:
   a. 90A – Installation of Air Conditioning and Ventilating Systems
5. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Publication:
   a. HVACTAB – HVAC Systems Testing, Adjusting and Balancing (HVACTAB)
   b. HVACDCS – HVAC Duct Construction Standards Metal and Flexible (HVACDCS)
   c. HVACALTM – HVAC Air Duct Leakage Test Manual (HVACALTM)
6. Underwriters Laboratories, Inc. (UL) Publications:
   a. 181 – Factory Made Air Duct Connectors
   b. 555 – Fire Dampers and Ceiling Dampers
   c. 555S – Leakage Rated Dampers for Use in Smoke Control Systems
   d. 586 – High Efficiency, Particulate, Air Filter Units
   e. 723 – Test for Surface Burning Characteristics of Building Materials
7. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 Mechanical Code
   b. 2020 Energy Conservation Construction Code

1.03 SUBMITTALS

A. Manufacturer’s Catalog Data:
   1. Dampers
   2. Flexible ducts and connectors
   3. Sheet Metals
   4. Test Holes

B. Drawings:
   1. Ductwork Layout Plan
   2. Location of test holes

C. Test Reports:
   1. Automatic dampers
      a. Submit certification of damper leakage testing and conformance with AMCA 500, the International Energy Conservation Code and Supplement, and specified maximum leakage or pressure drop requirements.
   2. Sound Pressure level rating
   3. Corrosion protection

D. Factory Test Reports:
   1. Sound attenuators and attenuator ducts acoustical tests
      a. Submit certified test data from an independent acoustical testing laboratory, listing sound noise reduction characteristics, static pressure drop, air flow velocity capacity, and insertion loss data.

E. Certificate of Compliance:
   1. Fire dampers and automatic dampers

F. Field Test Reports:
   1. Air duct leakage tests
   2. Testing and balancing of air systems

1.04 QUALITY ASSURANCE

A. SMACNA Duct Construction Manuals: The SMACNA recommendations shall be considered as mandatory requirements. Substitute the word "shall" for the word "should" in these manuals. No negative pressure construction for 4 inch, 6 inch, or 10 inch water gauge is provided herein.

1.05 TESTING FOR CORROSION PROTECTION

A. Comply with ASTM A123 or protect the equipment with a corrosion inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D1654.
   1. Corrosion Criteria: Upon completion of exposure, coating or paint shall show no indication of deterioration or loss of adhesion, nor shall there be indication of rust or corrosion extending further than 1/8 inch on either side of original scratch.
   2. Thickness of Coating: Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.

1.06 PRESSURE VELOCITY CLASSIFICATION

A. SMACNA HVACDCS, Section 1, and as indicated.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Galvanized Steel Sheets: ASTM A653; coating designation G90.

B. Galvanized Steel Hot Dipped After Fabrication: ASTM A123.

C. Aluminum Alloy Sheets: ASTM B209

D. Corrosion Resisting (Stainless) Steel Sheets: ASTM A167.

E. Duct Liner Adhesives: SMACNA HVACDCS, fire resistant adhesive.

2.02 DUCTS OF PRESSURE CLASSES 2-INCH OR LESS WATER GAUGE

A. Construction, metal gauge, hangars and supports, and reinforcements shall conform with SMACNA HVACDCS. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Air leakage shall be less than 5 percent of the system capacity. Construct ductwork of galvanized steel.
   1. Curved Elbows: Make a center line radius not less than 1-1/2 times the width or diameter of the duct.
   2. Joints: Make airtight. No dust marks from air leaks shall show at duct joints or connections to grilles, registers, and diffusers.
   3. Laps: Make laps at joints in the direction of airflow. Space button punch or bolt connection in standing seams at fixed centers not greater than 6 inches. Longitudinal locks or seams, known as "Button Punch Snap Lock" may be used in lieu of Pittsburg Lock.
   4. Fittings: Elbows, vaned elbows, take offs, branch connections, transitions, splitters, volume dampers, fire dampers, flexible connections, and access door shall conform with SMACNA HVACDCS, Section 2. Factory fabricate test holes to be airtight and noncorrosive with screw cap and gasket.
   5. Acoustical Attenuator Systems: Acoustical Duct Lining, Sound Attenuators (Traps), and Sound Attenuator Ducts:
      a. Acoustical Duct Lining: Flexible or rigid mineral fiber lining conforming to FS HH I 545. Lining shall not be less than one inch thick. Increase duct sizes indicated to compensate for the thickness of lining.
      b. Net Noise Reduction Values: Conform with the following:

Minimum Net Noise Reduction Values,
Sound Pressure Level dB
(Reference Sound Power at 10 12 Watts)

Octave Pass Band	2	3	4	5	6	7
Center Frequency (Hz)	125	250	500	1000	2000	4000
Noise Reduction (dB)	11	16	19	30	40	32

c. Preformed Duct Liner: Preformed round duct liner designed for insertion in round ducts may be used in the sizes commercially available. Provide duct liner sections with slip lap joints not less than 2 inches wide. Make joints in accordance with the printed instructions of the manufacturer. Furnish fire resistant adhesive to field coated joints when recommended by the manufacturer to prevent delamination or erosion at the joints. Tubular sections of duct liner shall fit the metal duct snugly and without gaps between duct liner sections.

d. Factory Fabricated Sound Attenuator Ducts: Sound attenuator ducts may be provided in lieu of sound attenuators. Comply with requirements specified herein for sound attenuators. Construct each double walled duct and fitting of an outer zinc coated metal pressure shell with one- inch thick acoustical blanket insulation and an internal perforated zinc coated metal liner. Install sufficient length of run to obtain the noise reduction value specified. The manufacturer shall certify that the sound reduction value specified will be obtained within the length of duct run provided. The internal perforated zinc coated metal liner shall be not less than 24 gauge, unless ribbed, then not less than 28 gauge for the duct liner and not less than 26 gauge for the fitting liner with perforations not larger than 3/32 inch diameter.

e. Sound Attenuators (Traps): Factory fabricated. Construct of galvanized steel sheets. The outer casing shall be not less than 22 gauge. Acoustical fills shall be mineral fiber conforming to FS HH I 545ASTM E84 and UL 723. Air flow capacities shall be as indicated. Pressure drops through the attenuators shall not exceed the values indicated, or shall be not in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Acoustically test sound attenuators with metal duct inlet and outlet sections while under the rated air flow conditions. Noise reduction data shall include the effects of flanking paths and vibration transmission. Construct attenuators to be airtight when operating at the internal static pressure not less than 2 inches water gauge. Conform with noise reduction requirements specified in paragraph entitled "Net Noise Reduction Values".

2.03 FLEXIBLE DUCTS

A. UL 181, Class I, UL listed, SMACNA HVACDCS, and additional requirements herein specified. Use to connect between rigid ducts and outlets or terminals. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream. At 250 degrees F, minimum rating pressures shall be 2 inches water positive and 1-1/2 inches negative up to 2500 cfm flexible ducts. Flexible ducts shall be maximum 3 feet in length. Minimum bend radius shall be twice of the duct diameter.

1. Materials: Interlocking spiral or helically corrugated type constructed of noncollapsible fire retardant, chloroprene or chlorosulphonated polyethylene impregnated, minimum 30 ounces per square yard woven mineral fabric.
2. Insulation and Vapor Barrier: ASTM C553; minimum one inch nominal thickness and one lb./cu. ft. density. The insulation shall be sheathed with a vapor barrier having a maximum water vapor permeance of 0.02 perm per ASTM E96, Procedure C. Coat ends of insulation with cement to prevent erosion and delamination.
3. Joints: Make airtight slip joints, seal with pressure sensitive vapor seal adhesive tape or duct sealer, and secure with sheet metal screws. To prevent insulation compression, place 2 inch wide by one inch thick closed cell foam plastic spacers over the joints under vapor barriers. To provide a vapor-tight joint, use a zinc coated steel clamp over such spacers.

2.04 FLEXIBLE CONNECTORS

A. UL 181, Class I, UL listed, SMACNA HVACDCS, and additional requirements herein specified. Connectors to be ASTM A653, 24-gauge galvanized steel, with commercial neoprene fire retardant coating meeting NFPA 701 with 500 lb tensile strength at a temperature range of -40ºF to 200ºF. Use to connect between rigid ducts and equipment inlets and outlets as indicated. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream.

2.05 DUCT SLEEVES AND PREPARED OPENINGS

A. Duct Sleeves and Closure Collars: Fabricate from minimum 20 gauge galvanized steel. Where sleeves are installed in bearing walls, provide structural steel sleeves as indicated.

B. Prepared Openings: Provide one inch clearance between the duct and the sleeve.

2.06 DEFLECTORS

A. Factory fabricated and factory or field assembled units consisting of curved turning vanes for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved vanes for square elbows.

B. For round ducts taking off from rectangular ducts, provide factory fabricated, galvanized sheet metal, spin in fittings. These fittings shall have scoop extractors, butterfly dampers, and locking quadrant operators.

2.07 ACCESS DOORS

A. Weld door frame in place. Door shall be rigid and airtight with neoprene gaskets and two or more galvanized steel hinges and tension fasteners. Provide doors as large as practical. Mount doors, if possible, so that air pressure holds them closed.

2.08 DAMPERS AND LOUVERS

A. Construct dampers and louvers with two gauges heavier than ducts in which installed. Except as modified herein, the construction shall be of aluminum or galvanized steel with interlocking edges and maximum 10 inch blade width. Conform with SMACNA HVACDCS. Dampers shall be opposed blade type where indicated.

B. Backdraft Dampers (Gravity Dampers or Shutters): Factory fabricated, with statically and dynamically balanced blades that open automatically when the fan starts and close by gravity when the fan stops. Provide the edges of blades with felt or rubber strips to prevent rattling.

C. Manual Volume Dampers: Balancing, factory fabricated type. Equip dampers with accessible mechanism such as quadrant operators or 3/16 inch rods brought through the side of ducts with locking setscrew and bushing. Where quadrant operators are used, they shall be chrome plated or enamel painted with all exposed edges rounded.

D. Automatic Dampers: Opposed blade dampers, factory fabricated of extruded aluminum, zinc-coated steel or stainless steel, with antifriction nonferrous bearings. Damper construction shall be in accordance with SMACNA Low Pressure Duct Construction Standards. Damper blades are to be foam insulated and thermally broken along with damper frame, leakage not to exceed 4” CFM/sq. ft. against 4” w.g. Damper operators shall have sufficient power to limit air leakage to the specified rate. Spring set to return to closed position and matching 120V actuator is to be provided as manufacturer accessory.

E. Bird Screens: ASTM E437, general industrial-use wire cloth, Grade C, (medium light) or heavier, nominal 2 mesh 0.063-inch wire diameter, aluminum bird screens. Provide removable insect screens of grooved type, with vinyl or neoprene spline insert for securing screen cloth.

2.09 DUCTWORK AND EQUIPMENT INSULATION

A. Section 23 07 00, “HVAC Insulation”.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall conform to NFPA 90A, SMACNA HVACDCS. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Use electrical isolation between dissimilar metals. Electrical isolation may be fluorinated elastomers or sponge rubber gaskets. Install ductwork accessories as indicated in accordance with the manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service.

1. Ductwork: When air distribution systems are operated, there shall be no chatter, vibration, or dust marks. After ducts are thermally or acoustically insulated, ensure air flow area equal to duct cross section dimensions indicated.
    a. Field Changes to Ductwork: Those required to suit the sizes of factory fabricated equipment actually furnished, shall be designed to minimize expansion and contraction. Use gradual transitions in field changes as well as modifications to connecting ducts.
    b. Dampers: When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer.
    c. Deflectors: Provide in square elbows, duct mounted supply outlets, take off or extension collars to supply outlets, and tap in branch off connections. Adjust supply outlets to provide air volume and distribution as indicated or specified.
    d. Fire Dampers: Install for ducts penetrating fire walls and where duct systems serve two or more floors in accordance with UL 555.
    e. Access Doors: Provide for automatic dampers, volume dampers, fire dampers, coils, thermostats, temperature controllers, valves, filters, humidifiers and other concealed apparatus requiring service and inspection in the duct systems.
    f. Duct Sleeves and Prepared Openings: Install for duct mains, duct branches, and ducts passing through roofs and ceilings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings.
        1) Duct Sleeves: Allow one inch clearance between duct and sleeve or one inch clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.

2) Prepared Openings: Allow one inch clearance between duct and opening or one inch clearance between insulation and opening for insulated ducts, except at grilles, registers, and diffusers.

3) Closure Collars: Provide not less than 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed. Fit collars snugly around ducts and insulation. Grind smooth edges of collar to preclude tearing or puncturing insulation covering or vapor barrier. Use nails with maximum 6 inch centers on collars.

2. Duct Hangers and Supports: SMACNA HVACDCS, Section 4. Unless otherwise indicated, provide not less than two one inch by 1/16 inch galvanized strap iron hangers spaced one on each side of duct. Anchor risers in the center of the vertical run to allow ends of riser free vertical movements. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. Where C clamps are used, use retainer clips.
   a. Flexible Ducts: Support ducts by hangers every 3 feet. Use stretch flexible air ducts to smooth out corrugations, and long radius elbows, where possible, using a minimum length to make connections.
   b. Flexible Connectors: Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc coated steel clinch type draw bands. For rectangular ducts, lock flexible connectors to metal collars.
3. Flashings: Provide waterproof flashings where ducts pass through exterior walls and roofs.
4. Inspection Plates and Test Holes: Provide, where required, in ductwork or casings for all balance measurements. Test holes shall be factory fabricated, airtight, and noncorrosive with screw cap and gasket. Extend cap through insulation.
5. Acoustical Duct Lining: SMACNA HVACDCS, Section 2. Apply the lining in cut to size pieces attached to interior of ducts with fire resistant adhesive. Top and bottom pieces shall lap the side pieces. Secure pieces together with welded pins or clips. Do not distort the ducts, burn through or mar the finish surface of ducts. Pins and washers shall be flush with the surface of duct liners. Seal breaks and punctures of duct liner coating with fire resistant adhesive. Coat exposed edges of the liner at duct ends and other joints where lining will be subject to erosion with a heavy brush coat of fire resistant adhesive, to prevent delamination of glass fibers. Duct

liners may also be applied to flat sheet metal with fire resistant adhesive, at top and bottom surface of ducts; then secure duct liners by welded pins or adhered clips.

6. Cleaning of Ducts: Remove all debris and dirt from ducts and wipe clean. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.

3.02 TESTING AND COMMISSIONING

A. The Contractor is responsible for the administration and direction of tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Notify Engineer 5 days before inspection or testing is scheduled. Correct all defects in the work. Repeat tests until the work is in compliance.

1. Performance Testing and Balancing: Section 23 05 93, “Testing and Balancing Air and Water Systems”.

END OF SECTION

SECTION 23 34 01

HVAC FANS

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for HVAC Fans, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Section 23 05 00 – Mechanical General Requirements
2. Section 23 05 93 – Testing and Balancing Air and Water Systems
3. Section 23 09 23 – Direct Digital Control Systems
4. Section 23 31 13 – Ductwork and Ductwork Accessories
5. Section 23 37 13 – Diffusers, Registers and Grilles
6. Division 26 – Electrical

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
1. Air Movement and Control Association, Inc. (AMCA) Publications:
   a. 210 – Laboratory Method of Testing Fans for Rating
   b. 220 – Test Method for Air Curtains
   c. 300 – Reverberant Room Method for Sound Testing of Fans
2. Air-Conditioning, Heating and Refrigeration Institute (AHRI) Publications:
   a. 880 – Air Terminals
3. Acoustical Society of America (ASA) Publication:
   a. 13 – Determination of Sound Levels of Noise Sources in a Special Reverberation Test Room
4. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) Publication:
   a. 68 – Testing In-Duct Sound Power Measurement Procedure for Fans
5. American Society for Testing and Materials (ASTM) Publications:
   a. A123 – Zinc (Hot Dip Galvanized) Coatings on Iron Steel Products
   b. B117 – Salt Spray (Fog) Testing
   c. D1654 – Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
6. National Electrical Manufacturers Association (NEMA) Publications:
   a. ICS2 – Industrial Control Devices, Controllers and Assemblies
   b. ICS6 – Enclosures for Industrial Controls and Systems
   c. MG1 – Motors and Generators

7. National Fire Protection Association (NFPA) Publications:
   a. 70 – National Electrical Code
   b. 90A – Installation of Air Conditioning and Ventilating Systems
8. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Publications:
   a. HVACTAB - HVAC Systems Testing, Adjusting and Balancing (HVACTAB)
9. Underwriters Laboratories, Inc. (UL) Publications:
   a. 507 – Electric Fans
   b. 705 – Power Ventilators
   c. 1278 – Wall- or Ceiling-Hung Electric Room Heaters
   d. 1995 – Terminal Units
10. Uniform Fire Prevention and Building Code of New York State Publications:
   a. 2020 Mechanical Code
   b. 2020 Energy Conservation Construction Code

1.03 SUBMITTALS

A. Manufacturer’s Data: Shop Drawings and Catalog Cuts. Submit shop drawings and catalog information showing plan, elevations, dimensions, capacities, accessories, controls, wiring diagrams, and ratings for the following:
   1. Fans
   2. Roof Curbs

B. Certificates of Compliance:
   1. Fans

C. Operation and Maintenance Manuals:
   1. Fans

1.04 MOTORS

A. NEMA MG1. Motor starters shall conform to NEMA ICS1 and NEMA ICS2. Determine specific motor characteristics to insure provision of correctly sized starters and overload heaters. Motors shall be designed to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified capacity under the most severe conditions likely to be encountered. When motor size provided differs from the size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate the equipment actually provided.

1.05 TESTING FOR CORROSION PROTECTION

A. Comply with ASTM A123, or protect the equipment with a corrosion inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to a marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D1654.

B. Corrosion Criteria: Upon completion of exposure, coating or paint shall show no indication of deterioration, loss of adhesion, or any indication of rust or corrosion extending further than 1/8 inch on either side of original scratch.

C. Thickness of Coating: Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.
   1. Mild Steel and Factory Primed Surfaces:
      a. Synthetic Resin Primer: 36 percent plus or minus 6 percent solids content by volume; 1 coat, 3 mils minimum dry film thickness.
      b. Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.
   2. Nonferrous Heat Exchanger Fin Coil Surfaces: Vinyl copolymer, 4 coats, 1-1/2 mils minimum dry film thickness per coat.
   3. Galvanized Surfaces:
      a. Polyamide Epoxy Primer: 48 percent plus or minus 2 percent solids content by volume; 1 coat, 2 mils minimum dry film thickness.
      b. Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.
   4. Aluminum Surfaces Other than Fin Coil Surfaces:
      a. Polyamide Epoxy Primer: 48 percent plus or minus 2 percent solid contact by volume; 1 coat, 2 mils minimum dry film thickness.
      b. Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.

PART 2 - PRODUCTS

2.01 FANS

A. Sound rating per AMCA 300; statically and dynamically balanced, with air capacities, brake horsepowers, fan types, fan arrangement, sound power levels or loudness level, and static pressure, as indicated. Fan bearing life shall have a minimum average life of 200,000 hours at design operating conditions. Provide

guard (bird) screens for outdoor inlets and outlets. Equip with automatic (back-draft) dampers. Have thermal overload protection in the operating disconnect switches within the building.

B. Centrifugal Fans: AMCA 210 with AMCA seal, galvanized steel housing, forward-curved type, direct drive motors, and injected molded polypropylene fan wheel and housing. Inlet box shall be 22-gauge galvanized steel with isolation mounted motor and galvanized steel motor mount. Motor shall be permanently lubricated, with built-in impedance or thermal overload protection, and disconnect plug. Provide with backdraft damper, isolator kit, white aluminum grille, and insulated housing. Provide with brick vent exhaust opening, 4-inch deep frame and 45 degree blades in locations indicated on contract drawings. Manufacture shall be as by Greenheck Model SP-A70, or approved equal.

C. Rooftop Exhaust Fans: AMCA 210 with AMCA seal, UL listed, downblast type with aluminum wheel, backward inclined centrifugal, statically and dynamically balanced, rigid internal support structure, leak proof, 16-gauge aluminum motor cover, shroud, curb cap and lower windband. Shroud shall have integral rolled bead, and lower windband shall have a formed edge. Drive frame assemblies shall be constructed of 14-gauge steel and mounted on rubber vibration isolators. Fan shall have aluminum bird screen, aluminum hinges, and 120v automatic air damper. Manufacture shall be as by Greenheck Model G, or approved equal.

1. Roof Curbs: Factory-fabricated sheet-steel structural members complying with National Roofing Contractors Association (NRCA) requirements. The curbs shall have high load-bearing capacities attained by a system of internal bulkheads, welded into position at logical intervals along the length of rails. Provide minimum 4-inch cants, 2- by 6-inch factory-installed wood nailers, and fully mitered end sections. Use welded 18-gauge galvanized steel shell, baseplate, and counterflashing.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install air distribution equipment as indicated and in accordance with the manufacturer's instructions. Provide clearance for inspection, repair, replacement, and service. Electrical work shall conform with NFPA 70 and Division 26, "Electrical". Provide overload protection in the operating disconnect switches and magnetic starters.

3.02 FIELD INSPECTION AND TESTS

A. Schedule and administer the specified tests. Provide personnel, instruments, and equipment for such tests. Correct defects and repeat the respective inspection and tests. Give the Engineer ample notice of the dates and times scheduled for tests and trial operations. Conduct inspection and testing in the presence of the Engineer.
   1. Field Inspection: Prior to initial operation, inspect equipment installation for conformance with drawings and specifications.

B. Field Tests:
   1. Preliminary Tests: For each item of air handling and distribution equipment and its components, perform an operational test for a minimum period of 4 hours.
   2. Testing and Balancing: After preliminary tests, test, adjust, and balance the air handling and distribution equipment in accordance with Section 23 05 93, "Testing and Balancing Air and Water Systems".

3.03 INSTRUCTION OF OPERATING PERSONNEL

A. Upon completion of the work, and acceptance of the installation, and at a time designated by the Owner, the services of a competent technician regularly employed or authorized by the manufacturer of the compactor shall be provided for instructing personnel in the proper operation, maintenance, safety and emergency procedures. The period of instruction shall be not less than two hours. The training shall be conducted at the job site during actual operation and coordinated with the Owner one week in advance.

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Diffusers, Registers and Grilles, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Section 23 05 00 – Mechanical General Requirements
2. Section 23 05 93 – Testing and Balancing of Air and Water Systems
3. Section 23 09 23 – Direct Digital Control Systems
4. Section 23 31 13 – Ductwork and Ductwork Accessories

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this Section:
1. Air Diffusion Control (ADC) Publication:
a. 1062-R4 – Certification, Rating and Test Manual
b. AD – Measurement of Room to Room Sound Transmissions Through Plenum Air Systems
2. Air Conditioning, Heating and Refrigeration Institute (AHRI) Publication:
a. 881 – Performance Rating of Air Terminals
3. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) Publication:
a. 70 – Performance of Air Outlets and Air Inlets Testing Method
4. American Society for Testing and Materials (ASTM) Publication:
a. A123 – Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
b. A527 – Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process Lock Forming Quality
c. B117 – Corrosive Environments Salt Spray Test
d. C423 – Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
e. C553 – Mineral Fiber Blanket and Felt Insulation for Commercial and Industrial Applications
f. D870 – Water Immersion Test
g. D2794 – Reverse Impact Cracking Test
5. National Fire Protection Association (NFPA) Publication:
a. 90A – Installation of Air Conditioning and Ventilating Systems
6. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) Publications:

a. HVACTAB – HVAC Systems Testing, Adjusting and Balancing (HVACTAB)
b. HVACDCS – HVAC Duct Construction Standards Metal and Flexible (HVACDCS)

7. Underwriters Laboratories, Inc. (UL) Publication:
   a. 181 – Factory Made Air Duct Connectors
8. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 Mechanical Code

1.03 SUBMITTALS

A. Manufacturer's Data:
   1. Diffusers, registers and grilles
      a. Submit a schedule of all inlets and outlets indicating location, catalog model number, manufacturer, dimensional information, sound pressure level rating, nominal rated volumetric flow rate (cfm), neck or face velocity at specified cfm, pressure drop at specified cfm, throw and drop for outlets, range for diffusers, and maximum and minimum cfm modulation.

B. Test Reports:
   1. Sound pressure level rating
      a. Submit for inlets and outlets including diffusers, registers and grilles.

1.04 QUALITY ASSURANCE

A. SMACNA Duct Construction Manuals: The SMACNA recommendations shall be considered as mandatory requirements. Substitute the word "shall" for the word "should" in these manuals.

PART 2 - PRODUCTS

2.01 DIFFUSERS, REGISTERS, AND GRILLES

A. Material and Finishes: Construct diffusers, registers, and grilles of aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Air outlets shall be factory treated and painted with a baked on anodic acrylic paint and pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must also meet testing requirements in accordance with ASTM B870 and D2794. Colors shall be selected or approved by the Engineer.

B. Sound Pressure Level: Manufacturer certified sound pressure level rating of inlets and outlets in accordance with ADC 1062 R4. Conform with the following permissible room sound pressure levels:

NC Range, dB	Typical Application
20 – 25	Private Offices and Conference Rooms
30 – 40	Corridors
25 – 30	Classrooms
20 – 25	Courtrooms

C. Throw: Defined as distance from the diffuser, register, or grille to the point which the air velocity falls below 50 feet per minute. Throw shall not exceed 1.5 times the outlet mounting height.

D. Drop: Maximum drop of air stream shall not be so great that it is within 5 feet of the floor at the end of the throw.

E. Ceiling Diffusers: Equip with baffles or other devices required to provide proper air distribution pattern. Provide factory fabricated, single key, volume dampers. Except for linear air diffusers, internal parts shall be removable through the diffuser neck for access to the duct and without the use of special tools.

1. Circular, Square, and Rectangular Diffusers: Construct each ceiling diffuser of three precision die-stamped cones designed to deliver air in a generally horizontal direction without excess smudging of the ceiling. The back cone shall include an integrally drawn inlet. The two inner cones shall be constructed as a single, removable inner core assembly with removal center plug to allow adjustment of inlet damper without removal of inner core assembly. Diffusers shall be supplied with a round damper operable from the face of the diffusers. Diffusers shall be in lay-in type or plaster mounted frame of 24”x24” or 12”x12” as indicated. Manufacture shall be as by Titus Model TMS, or approved equal.
2. Security Diffusers: Ceiling mounted, maximum security type, constructed of 16-gauge steel and mounted with stainless steel tamper proof screws. The edge of the face flange shall be manufactured with a beveled slope and rest flat on the ceiling. The cores shall be 3-1/4-inch deep comprised of cross sections fabricated with multiple directional changes. Diffuser shall be equipped with an opposed blade damper and provide horizontal discharge patterns in multiple directions with maximum security without a faceplate.

F. Supply Registers: Double deflection supply registers with front deflection blades parallel to the long dimension of the register. Blades shall be spaced on 3/4-inch centers. Provide manufacturer furnished volume dampers furnished by the manufacturer. Volume dampers shall be of the group operated, opposed blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face. Manufacture shall be as by Titus Model 300 RL, or approved equal.

G. Return/Exhaust Registers: Provide exhaust and return registers as specified for supply registers, except that they shall have a single set of nondirectional face bars or vanes having the same appearance as the supply registers. Set face bars or

vanes at 45 degrees. Registers shall be in lay-in type or plaster mounted frame of 24”x24” or 12”x12” as indicated. Manufacture shall be as by Titus Model 350 RL, or approved equal

H. Grilles: Border and grille of heavy extruded aluminum with thickness of 0.040-0.050 inches and countersunk screw holes, with a minimum free area of 90%. Border shall be interlocked at the four corners and mechanically staked to form a rigid frame. Grid size shall be ½ x ½ x 1 inch. Grilles shall be in lay-in type or plaster mounted frame of 24”x24” or 12”x12” as indicated. Manufacture shall be as by Titus Model 50F, or approved equal.

I. Security Registers: Ceiling mounted, maximum security type, constructed of 12-gauge steel with the outer perimeter (face flange) stamped to raise the grille 5/16 inches from the ceiling. The edge of the face flange shall be manufactured with a beveled slope and rest flat on the ceiling. The throat of the grille shall be 1-7/16” deep comprised of horizontal “S” channel blades and vertical mullions to create a rigid 2-inch x 1/8-inch opening. The grille shall be security to a rear mounting duct collar using threaded rods attached to coupling nuts on the back of the grille, and shall be supplied with an opposed blade damper adjustable from the rear.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall conform to NFPA 90A, SMACNA HVACDCS. Install diffusers, registers, grilles and accessories as indicated in accordance with the manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service.

3.02 FIELD TESTS AND INSPECTIONS

A. The Contractor is responsible for the administration and direction of tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Correct all defects in the work. Repeat tests until the work is in compliance.

1. Performance Testing and Balancing: Testing and Balancing shall be performed in accordance with Section 23 05 93, “Testing and Balancing Air and Water Systems”.

END OF SECTION

SECTION 23 52 16

CONDENSING BOILERS

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Condensing Boilers, as shown on the Plans, as specified and/or directed.

B. Related work specified elsewhere:
1. Section 23 05 00 – Mechanical General Requirements
2. Section 23 05 93 – Testing and Balancing of Air and Water Systems
3. Section 23 07 00 – HVAC Insulation
4. Section 23 09 23 – Direct Digital Control Systems
5. Section 23 11 23 – Fuel Gas Piping
6. Section 23 21 13 – Hydronic Piping and Specialties
7. Section 23 21 23 – Hydronic Pumps

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
1. Air Conditioning, Heating and Refrigeration Institute (AHRI) Publication:
   a. 1500 - Performance Rating of Commercial Space Heating Boilers
2. American National Standards Institute, Inc. (ANSI) Publication:
   a. B31.1 – Power Piping
   b. B31.9 – Building Services Piping
   c. B40.100 – Gauges-Pressure and Vacuum, Indicating Dial Type-Elastic Element
   d. B40.200 – Thermometers, Direct Reading and Remote Reading
   e. Z21.13 – Gas-fired Low Pressure Steam and Hot Water Boilers
   f. Z49.1 – Safety in Welding and Cutting
3. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) Publication:
   a. 90.1-2016 – Energy Standard for Buildings Except Low-rise Residential Buildings
4. American Society of Mechanical Engineers (ASME) Publication:
   a. BPV – Boiler and Pressure Vessel Code and Interpretations
   b. BPVSEC4 – Heating Boilers
   c. BPVSEC8 – Pressure Vessels (Division 1)
   d. CSD-1 – Controls and Safety Devices for Automatically Fired Boilers
   e. PTC4.1 – Steam Generating Units
5. American Society for Testing and Materials (ASTM) Publication:
   a. D1785 – PolyVinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120

b. D2564 – Solvent Cements for PolyVinyl Chloride (PVC) Plastic Piping Systems

6. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publication:
   a. SP 58 – Pipe Hangers and Supports-Materials, Design and Manufacture
   b. SP 67 – Butterfly Valves
   c. SP 69 – Pipe Hangers and Supports-Selection and Application
7. National Fire Protection Association (NFPA) Publication:
   a. 54 – National Fuel Gas Code
   b. 58 – Liquefied Petroleum Gas Code
   c. 211 – Chimneys, Fireplaces, and Vents
8. New York State Department of Labor Publication:
   a. 12 NYCRR – Industrial Code Rule 4
9. Underwriter's Laboratory (UL) Publication:
   a. 1738 – Venting Systems for Gas-Burning Appliances, Categories II, III, and IV
10. Uniform Fire Prevention and Building Code of New York State Publication:
   a. 2020 Mechanical Code
   b. 2020 Energy Conservation Construction Code
   c. 2020 Fuel Gas Code

1.03 SUBMITTALS

A. Manufacturer's Data: Shop Drawings and Catalog Cuts. Submit shop drawings and catalog information showing plan, elevation, dimensions, capacities, accessories, controls, wiring diagrams, vent sizing and arrangement, and ratings for the following:
   1. Boiler(s), boiler trim and accessories
   2. Venting

B. Certificates of Compliance: Manufacturer's Certificate: Submit manufacturer's certificate of boiler performance.

C. ASTM Stamp Certification and Report: Submit "H" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of pipe external to boiler.

1.04 QUALITY ASSURANCE

A. Standard Commercial Product for Boilers: Boiler(s) shall be the manufacturer's standard commercial product. Prior to commencement of construction the Contractor shall submit a certified written report from the boiler manufacturer to show that substantially identical equipment of comparable capacity (within 20 percent) has been successfully installed and operated in at least three installations under similar operating conditions. The report shall include the date of

installation, type, model, capacity and address location of installed boiler(s). A standard commercial product is a product which has been sold or is currently being offered for sale, on the commercial market through advertisements or manufacturer's catalogs, or brochures.

B. Service Availability: The Contractor shall submit a certified list of qualified permanent service organizations for boiler(s), boiler controls, and instrumentation which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 - PRODUCTS

2.01 BOILERS

A. Type 316L stainless steel heat exchanger, low pressure, sealed combustion, power vented, high efficiency type provided complete with modulating burner, minimum efficiency rating of 95% and AHRI gross capacity as scheduled on drawings. Boiler burner unit shall be stainless steel and be capable of burning natural gas having a minimum of 4" wc and a maximum pressure of 13" w.c. at the fuel train connection with a 5 to 1 turndown ratio. Adequate tappings shall be provided for all accessories and fittings specified herein and as required for code compliant installation.

B. Boiler Trim: Provide all necessary accessories for a complete installation in conformance with all applicable codes and regulations including but not limited to the following items:
1. ASME certified side outlet pressure relief valve set to 30 psig and piped to 6 inches above finished floor.
2. Combination pressure-temperature gauge.
3. UL listed and ASME rated external float-type low water cut-off device with auto-reset.
4. High temperature limit control with manual reset.
5. Built-in freeze protection
6. Flue gas, outlet water temperature and return water temperature sensors.

C. Boiler Certification: The boiler manufacturer shall submit evidence that the boiler(s) meet the requirements of the standards specified. Acceptable evidence of meeting these standards will be the official UL listing mark prescribed in the UL gas and oil equipment list for oil-fired or gas-fired boiler assemblies, as applicable plus the appropriate official ASME symbol stamp. In lieu of the above certification, acceptable evidence of meeting the requirements of one or more of the standards specified will be a certified test report from an approved testing laboratory, indicating that the boiler(s) and accessories have been inspected and tested and meet all requirements of the applicable standards specified below.

D. Boiler Control and Instrument Cabinet(s): The boiler controls and safety devices shall meet the requirements of ASME CSD-1. Integral factory wired operating controls with electronic display for boiler set-up, status, and diagnostics, to control all operations and energy inputs of the boiler, and shall have the capacity to modulate two condensing boilers and boiler pumps utilizing an automatic lead-lag mode to rotate the firing order of units and equalize operating time. The controls shall operate the boiler pumps with an adjustable post purge cycle. The boiler setpoint temperature shall be based on outdoor temperature reset and shall include an outdoor temperature sensor. The system shall also start and stop the primary circulating pumps (P-1 and P-2) using lead-lag mode to rotate pump operation based on a demand from the thermostats for heating. Controls system shall include supply water temperature sensor, return water temperature sensor, and outdoor temperature sensor. Boiler controls shall have the capability of communicating with the new DDC control system as specified in Section 23 09 23, "Direct Digital Control System for HVAC".

E. Feedwater Treatment: Provide shot feeder for the chemical treatment of the boiler makeup feedwater. Water treatment, including pH control, shall be compatible with and recommended and approved by the boiler manufacturer for use with stainless steel heat exchangers.

F. Condensate Neutralizer Kit: Factory fabricated, two-capsule module with a 4.0 gallon/hour capacity, supplied as an accessory to the boiler equipment. The module consists of 0.5-gallon capsules with an initial charge of neutralizing agent and neutralization media, two 3-inch fill/access openings, ½" threaded inlet and outlet, three ½" NPT to hose barb fittings, ½" barbed Y fitting, six hose clamps, 10 feet of ½" vinyl tubing, and two base/wall mounting clamps.

G. Propylene Glycol: Provide 20% propylene glycol mixture with water for circulating fluid. Propylene glycol to be compatible with and recommended and approved by the boiler manufacturer for use with stainless steel heat exchangers.

H. Propylene Glycol Fill Station: Factory fabricated, automatic and autonomous make-up glycol system package, consisting of a pressurization assembly mounted on a translucent polyethylene 6-gallon solution container complete with cover. System shall be designed to operate at a maximum temperature of 130ºF with a factory discharge pressure setting of 12 PSIG. Pressurization assembly shall include pressurization pump with pressure controls, a pressure reducing valve, and pressure gauge. The pressurization pump shall operate on a 110V, 60 Hz motor and maintain fill pressure in the glycol system. The Glycol Solution (20% Propylene Glycol/Water Solution) shall be compatible with a stainless steel heat exchanger and approved by the Boiler manufacturer for use with their equipment.

2.02 BOILER VENTING AND COMBUSTION AIR

A. Boiler Venting: Provide direct vent type using Schedule 40 PVC, ASTM D1785, and cement solvent fittings per ASTM 2564. Terminate vent with vertical concentric vent, per manufacturer's recommendations.

B. Boiler Combustion Air: Provide direct vent type combustion air directly from outside to boiler using Schedule 40 PVC, ASTM D1785, with cement solvent fittings per ASTM 2564. Terminate with horizontal concentric vent, per manufacturer's recommendations.

C. Concentric Vent Termination: Horizontal concentric vent termination shall be sidewall termination vent cap kit with cap, inside/outside cover plates, bird screen and mounting hardware for use with Schedule 40 PVC pipe as provided by boiler manufacturer Concentric vent kits shall be joined with cement solvent fittings per ASTM 2564.

2.03 GAS PIPE AND FITTINGS

A. Gas Pipe and Fittings shall be as specified in Section 23 11 23, "Fuel Gas Piping".

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Arrange work in a neat and orderly manner so that minimum storage of equipment and material is required at the project site. All parts shall be readily accessible for inspection, repair, and renewal. Protect material and equipment from the weather. Rigging, erection, installation and start-up assistance of the boiler equipment and accessory systems shall be conducted in complete accordance with the manufacturer's recommended procedures, all applicable local, State and Federal codes, and as specified herein.

B. Coordination of Work: The Contract Drawings indicate a diagrammatic arrangement of the intended equipment systems. The Contractor shall use the Contract Drawings as a guide for the final installations, following the indicated arrangements as closely as is practicable. Maximize headroom and access space around all equipment components and provide neat and concise piping and equipment arrangements. Provide adequate access to all valves, controls, equipment and other devices requiring maintenance and manual operation. Maintain working clearances around boilers and related equipment in accordance with the 2020 Mechanical Code of New York State and Industrial Code Rule 4.

C. Boilers and Accessories: The Contractor shall provide all labor, materials, equipment, supervision, and specialties necessary to accomplish the installation of the new boiler system and associated accessories. Install and locate all boiler system and accessory equipment in accordance with the Contract Drawings. All work shall be performed by skilled professional tradesman under the direction of experienced supervisors and the manufacturer's representative. Minor alternations and/or revisions shall be brought to the attention of the Engineer for approval prior to the commencement of such work. Boilers and other equipment components shall be handled with care during transport and rigging so as to prevent damage to those items of equipment. Equipment shall be lifted only by the designated lifting lugs or as approved by the manufacturer. Provide all temporary cribbing and shoring as required to facilitate the installation of equipment. Distribute loads implied on existing walls and structures so as to prevent any point loading which could result in damage to those structures. Any damage to existing structures shall be repaired to original condition by the Contractor at no expense to Owner.

D. Boiler Venting and Combustion Air: Install concentric vent system strictly in accordance with installation instructions of the manufacturer.

3.02 SYSTEM CLEANING

A. Boiler System Cleaning: After installation of boiler, thoroughly clean the distribution system to remove sediment prior to connecting the boiler. Flush system until water runs clean and the system is free of sediment. Following treatment of the distribution system, refill boiler and associated piping with glycol meeting the manufacturer's requirements for acceptable water chemistry. At all times after initial cleaning, the Contractor is responsible to protect the boiler, tanks, and piping against internal corrosion until testing is completed and the boiler(s) is accepted. Contractor to provide all chemicals, labor for introducing chemicals, and professional services for control and supervision of the treatment process.

B. Cleaning of Systems: As installation of the various system components is completed, adequately clean each before final closing. Remove all foreign matter from equipment and surrounding areas. Preliminary or final tests are not permitted until the cleaning is approved.

3.03 TESTING AND COMMISSIONING

A. General: The Contractor is responsible for the performance of all inspections and tests as specified herein to demonstrate that the boiler(s) and auxiliary equipment, as installed, are in compliance with contract requirements. Fill and test the boiler system, and purge air from the system in accordance with manufacturer's requirements and instructions. Start up and initially operate the system with all components operating. Inspect and check thermostat circuits, condensate system

lines, fittings and traps, and all other final checks prior to starting the boiler in accordance with manufacturer's installation instructions. During this time, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water occurs when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. Contractor shall furnish all labor, equipment, and test apparatus. In accordance with the General Provisions, the Contractor will furnish water, electricity, and fuel.

B. Inspections: The Contractor shall operate boilers and all appurtenances prior to final testing and shall insure that all necessary adjustments have been made. Submit 24 hour advanced written notice indicating the equipment is ready for inspection and testing. Contractor provide testing equipment, including gages, thermometers, calorimeter, thermocouple pyrometers, fuel flow meters, water meters, and other test apparatus and set up and calibrated prior to the test. Draft, fuel pressure, and water flow may be measured by permanent gages and meters installed under the contract. The Contractor is responsible for providing an analysis of the fuel being used for the tests. The tests shall include the following performed, when feasible, in the sequence as listed:

1. Strength and tightness tests
2. Standards compliance tests
3. Combustion tests
4. Operational tests
5. Capacity and efficiency tests
6. Tests of auxiliary equipment

C. Strength and Tightness Tests: After installation and connection, subject boilers to an inspection and hydrostatic test to determine that the boiler and appurtenances were not damaged in transit or handling. Hydrostatic test in accordance with ASME BPV, with the test pressure applied for a period of 8 hours. This test is in addition to the hydrostatic tests performed at the factory.

D. Combustion Tests: Test the fuel burning and combustion control equipment with the specified fuel at 3 different loads and average them to meet 80 percent of the full rated load. Tests shall be conducted by factory trained combustion equipment representative.

E. Operational Test: Test the boiler(s) continuously for a period of at least 8 hours to demonstrate proper operability of the combustion control, flame safeguard control, and safety interlocks. Conduct this test after the adjustment of the combustion controls has been completed under the combustion test.

F. Capacity and Efficiency Tests: Perform the capacity and efficiency tests after satisfactory completion of all tests previously specified herein and after the boiler(s) have been operating continuously for 2 days with no nuisance shutdowns and without the necessity for frequent or difficult adjustments. Perform these tests on each boiler. Conduct tests using the specific fuel. Test in accordance with the heat loss method of ASME PTC4.1 and report on the ASME Test Form for Abbreviated Efficiency Test. The duration of the tests shall be sufficient to record all necessary data but in no case less than 4 hours.

G. Auxiliary Equipment and Accessory Tests: Observe and check all pumps and other accessories and appurtenant equipment during the operational and capacity tests for leakage, malfunctions, defects, noncompliance with referenced standards, or overloading, as applicable.

3.04 INSTRUCTION OF OPERATING PERSONNEL

A. Upon completion of the work, and acceptance of the installation, and at a time designated by the Owner, the services of a competent technician regularly employed or authorized by the manufacturer of the system shall be provided for instructing personnel in the proper operation, maintenance, safety and emergency procedures. The period of instruction shall be not less than four hours. The training shall be conducted at the job site during actual operation and coordinated with the Owner one week in advance.

END OF SECTION

SECTION 23 74 16

PACKAGED ROOFTOP AIR CONDITIONING UNIT

PART 1 - GENERAL

1.01 SUMMARY

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Packaged Rooftop Air Conditioning Unit, as shown on the Plans, as specified, and/or directed.

B. Related work specified elsewhere:
1. 23 05 00 – General Mechanical Requirements
2. 23 05 53 – Identification for HVAC Piping and Equipment
3. 23 05 93 – Testing and Balancing of Air and Water Systems
4. 23 09 23 – Direct Digital Controls
5. 23 11 23 – Fuel Gas Piping
6. 23 31 13 – Ductwork and Ductwork Accessories
7. Division 26 – Electrical

1.02 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
1. Air Conditioning, Heating and Refrigeration Institute (AHRI) Publication:
   a. 210/240 – Unitary Air Conditioning and Air-Source Heat Pump Equipment
   b. 260 – Application, Installation and Servicing of Unitary Systems
   c. 340/360 – Commercial and Industrial Unitary Air Conditioning Equipment
   d. DCAACP – Directory of Certified Applied Air Conditioning Products
   e. DCUAC – Directory of Certified Unitary Air Conditioners
2. Air Movement and Control Association International, Inc. (AMCA)
   a. 210 – Laboratory Method of Testing Fans for Rating
   b. 300 – Reverberant Room Method for Sound Testing of Fans
   c. 500 – Laboratory Methods of Testing Louvers, Dampers and Shutters
   d. 511 – Product Rating Manual for Air Control Devices
3. American National Standards Institute, Inc. (ANSI) Publication:
   a. B16.22 – Wrought Copper and Bronze Solder-Joint Pressure Fittings
   b. B31.5 – Refrigerant Piping
   c. Z21.47 – Gas-fired Central Furnaces

4. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) Publication:
    a. 15 – Safety Code for Mechanical Refrigeration
    b. 52 – General Ventilation Air-Cleaning Devices for Removal Efficiency by particle Size
    c. 62.1 – Ventilation for Acceptable Indoor Air Quality
    d. 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
    e. 135 – BACNET™ — A Data Communication Protocol for Building Automation and Control Networks
5. American Society for Testing and Materials (ASTM) Publication:
    a. A123 - Zinc (Hot Dip Galvanized) Coatings on Iron Steel Products
    b. B117 - Salt Spray (Fog) Testing
    c. D1654 - Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
    d. E477 - Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers
6. National Electrical Manufacturers Association (NEMA) Publication:
    a. ICS2 – Industrial Control Devices, Controllers and Assemblies
    b. ICS6 – Enclosures for Industrial Controls and Systems
    c. MG1 – Motors and Generators
7. National Fire Protection Association (NFPA) Publication:
    a. 70 - National Electrical Code
    b. 90A - Installation of Air Conditioning and Ventilating Systems
8. Uniform Fire Prevention and Building Code of New York State Publication:
    a. 2020 Mechanical Code of New York State
    b. 2020 Energy Conservation Construction Code of New York State

1.03 SUBMITTALS

A. Manufacturer's Data:
    1. Rooftop Unit
    2. Roof Curb

B. Test Reports:
    1. Rooftop Unit Field Test Reports – Include certification by the equipment manufacturer's representative

C. Certificate of Conformance:
    1. Rooftop Unit

D. Operation and Maintenance Manuals:
    1. Rooftop Unit

1.04 TESTING FOR CORROSION PROTECTION

A. Comply with ASTM A123, or protect the equipment with a corrosion inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B117. Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to a marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D1654.
   1. Corrosion Criteria: Upon completion of exposure, coating or paint shall show no indication of deterioration, loss of adhesion, or any indication of rust or corrosion extending further than 1/8 inch on either side of original scratch.
   2. Thickness of Coating: Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.
      a. Mild Steel and Factory Primed Surfaces:
         1) Synthetic Resin Primer: 36 percent plus or minus 6 percent solids content by volume; 1 coat, 3 mils minimum dry film thickness.
         2) Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.
      b. Nonferrous Heat Exchanger Fin Coil Surfaces: Vinyl copolymer, 4 coats, 1-1/2 mils minimum dry film thickness per coat.
      c. Galvanized Surfaces:
         1) Polyamide Epoxy Primer: 48 percent plus or minus 2 percent solids content by volume; 1 coat, 2 mils minimum dry film thickness.
         2) Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.
      d. Aluminum Surfaces Other than Fin Coil Surfaces:
         1) Polyamide Epoxy Primer: 48 percent plus or minus 2 percent solid contact by volume; 1 coat, 2 mils minimum dry film thickness.
         2) Vinyl Copolymer: 23 percent plus or minus 4 percent solids content by volume; 2 coats, 1-1/2 mils minimum dry film thickness per coat.

1.05 MOTORS

A. NEMA MG1. Motor starters shall conform to NEMA ICS1 and NEMA ICS2. Determine specific motor characteristics to insure provision of correctly sized starters and overload heaters. Motors shall be designed to operate at full capacity with a voltage variation of plus or minus 10 percent of the motor voltage rating. Motor size shall be sufficient for the duty to be performed and shall not exceed its full load nameplate current rating when driven equipment is operated at specified

capacity under the most severe conditions likely to be encountered. When motor size provided differs from the size indicated or specified, the Contractor shall make the necessary adjustments to the wiring, disconnect devices, and branch circuit protection to accommodate the equipment actually provided.

1.06 SAFETY

A. Comply with OSHA 29 CFR 1910.

B. Design, manufacture, and installation of mechanical refrigeration equipment shall conform to ASHRAE 15.

PART 2 - PRODUCTS

2.01 MATERIALS

A. ROOFTOP AIR CONDITIONING UNIT (RTU): The unit shall be a factory assembled and packaged combination heating and cooling unit. Unit shall be available for direct expansion cooling only, or direct expansion cooling with natural gasheating. Provide unit with suitable lifting attachments, downflow duct, filters, outside air system, barometric relief system, optional non-fused disconnect switches, hinged access doors, roof curb, base rail, and all operating and safety controls furnished factory installed. Submit data to demonstrate that the unit will produce the performance factors specified and/or scheduled. The unit capacity, electrical characteristics, optional accessories and operating conditions shall be as scheduled on Contract Drawings, and have a minimum EER of 11.2 when tested in accordance with AHRI 340/360. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant charge (R-410A), and special features required prior to field startup. Manufacture shall be as by Trane Model YHC, or approved equal.

1. Casings: Construct casings of double-wall zinc coated galvanized steel, with mid-space internal thermal break between panels. Provide removable panels and access doors for inspection and access to internal parts. Roof and panel insulation in contact with the return and conditioned air stream shall have ½-inch thick foil faced fiberglass insulation. External surface of unit casing shall be factory coated with a minimum 1.5 mil enamel finish and tested in accordance with ASTM B117.
2. Supply Blower (Fan) Sections: Supply fans shall be centrifugal forward-curved fans mounted on a common shaft with fixed sheave drive. Fans shall be direct drive, statically and dynamically balanced at factory. Fans shall be mounted on grease lubricated ball bearings. Entire assembly shall be completely isolated from unit board by double deflection rubber-in-shear isolators. Fan motor shall be open drip proof, speed controlled by rooftop unit controller, premium efficiency with thermal overload protection and phase failure protection. Fan motor shall meet MG1 requirements, and comply with NEMA premium efficiency levels.

3. Condenser Fan: Fans shall be direct-driven dynamic profile for low tip speed, and low noise blade design. Fan motors shall be permanently lubricated with built-in current and thermal overload protection.
4. Phase Monitor: Three-phase line monitor, with LED indicators for ON and FAULT.
5. Condensing Section: Units shall incorporate R-410A refrigerant circuits containing fully hermetic scroll type compressors. The motor shall be suction gas-cooled hermetic design. Compressor shall have centrifugal oil pump with dirt separator, oil sight glass, and oil charging valve. Compressor shall be provided with thermostatic motor winding temperature control. Compressor section shall be provided with hail guards.
6. Refrigerant Circuits: Each refrigerant circuit shall have independent thermal expansion valves, service pressure ports, and refrigerant line filter driers.
7. Evaporator and Condenser Coils: Direct expansion coil fabricated of seamless copper tubing mechanically expanded into high efficiency aluminum plate fins, leak tested to 465 psig. Condenser coils shall be microchannel type.
8. Heating Section: Gas Heating section shall be natural gas-fired, forced draft, direct spark ignition system, factory mounted, and constructed of corrosion resistant steel heat exchanger and burners. The system shall have single or two-stage heating, initial purge sequence, high temperature limit switch, and three ignition attempts before system lockout.
9. Filter Section: Throwaway type with 2-inch filters, and MERV 8 rating.
10. Powered Convenience Outlet: Provide GFCI, 120V/15 amp, 2-plug powered convenience outlet on unit.
11. Economizer: Unit shall be provided with an outdoor air economizer including outdoor, return and exhaust air parallel blade dampers. Economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling. Outdoor air hood shall be factory installed and constructed of galvanized steel, and shall include moisture eliminator filters, and bird screen on intake and exhaust openings. Damper actuators shall be modulating, spring return type. Economizer control shall utilize comparative enthalpy control to sense and compare both outdoor and return air enthalpy. Fully modulating 0-100% motor and dampers, barometric relief, minimum position setting, preset linkage, and differential enthalpy control.
12. Roof Curb: Roof curb shall be pre-fabricated 14-gauge galvanized steel, designed to mate with down flow unit and provide support and water tight installation for field assembly. Curb shall provide field-fabricated rectangular supply/return ductwork to connect directly to curb and include wood nailer strips. Gasket shall be provided for field mounting between the unit base and roof curb.

B. Controls: Provide a completely integrated microprocessor based Direct Digital Control (DDC) system to control all functions as follows:
   a. Temperature Control.
   b. Scheduling.
   c. Monitoring.
   d. Unit safety protection, including compressor minimum run and minimum off times and diagnostics.
   e. All required temperature sensors, pressure sensors, controller and keypad/display operator interface.

1. The DDC control system shall be standalone and shall maintain existing set points and schedules in a nonvolatile memory. DDC control system shall permit starting and stopping locally or remotely and provide remote alarm indication. Unit control system shall provide outside air damper actuation, emergency shutdown, remote head enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation. The unit control system shall have built-in time schedule programmable from unit keypad interface. All control settings shall be password protected. User interface interaction with the display provides the following information as a minimum:
   a. Return air temperature.
   b. Discharge air temperature.
   c. Outdoor air temperature.
   d. Space air temperature.
   e. Outdoor enthalpy, high/low.
   f. Compressor suction temperature and pressure.
   g. Compressor head pressure and temperature.
   h. Expansion valve position.
   i. Condenser fan speed.
   j. Inverter compressor speed.
   k. Dirty filter indication.
   l. Airflow verification.
   m. Cooling status.
   n. Control temperature (changeover).
   o. VAV box output status.
   p. Cooling status/capacity.
   q. Unit status.
   r. All time schedules.
   s. Active alarms with time and date.
   t. Previous alarms with time and date.
   u. Optimal start.
   v. Supply fan and exhaust fan speed.
   w. System operating hours (supply fan, exhaust fan, cooling, individual compressor, heating, economizer, tenant override).

2. User interface with keyboard shall provide the following:
   a. Controls mode:
      1) Off manual
      2) Auto
      3) Heat/Cool
      4) Cool only
      5) Heat only
      6) Fan only
   b. Occupancy mode:
      1) Auto
      2) Occupied
      3) Unoccupied
      4) Tenant override
   c. Unit operation changeover control:
      1) Return air temperature
      2) Space temperature
      3) Network signal
   d. Cooling and heating change-over temperature with 5ºF deadband.
   e. Cooling discharge air temperature (DAT)
   f. Supply reset options:
      1) Return air temperature
      2) Outdoor air temperature
      3) Space temperature
      4) Airflow (VAV)
      5) Network signal
      6) External (0-10 vdc)
      7) External (0-20 mA)
   g. Temperature alarm limits:
      1) High supply air temperature
      2) Low supply air temperature
      3) High return air temperature
   h. Lockout control for compressors.
   i. Compressor interstage timers.
   j. Night setback and setup space temperature.
   k. Building static pressure.
   l. Economizer changeover:
      1) Enthalpy
      2) Dry bulb temperature
   m. Currently time and date.
   n. Tenant override time.
   o. Occupied/unoccupied time schedule.
   p. One event schedule.
   q. Holiday dates and duration.
   r. Adjustable set points.

s. Service mode:
   1) Timers normal (all time delays normal).
   2) Timers fast (all time delays 20 sec).

t. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:
   1) Zone sensor with tenant override switch
   2) Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)

u. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
   1) Airflow
   2) Outside air temperature
   3) Space temperature
   4) Return air temperature
   5) External signal of 1-5 vdc
   6) External signal of 0-20 mA
   7) Network signal

PART 3 - EXECUTION

3.01 INSTALLATION: AHRI 260, AND AS SPECIFIED HEREIN

A. General: Install equipment and components in a manner to insure proper and sequential operation of the equipment and equipment controls. Installation of equipment shall be in accordance manufacturer's instructions and as indicated. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations, equipment rails and roof curbs for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated on drawings. Locate equipment to allow working space for all necessary servicing such as component removal, disassembling compressors, replacing or adjusting drives, motors, access to automatic controls, refrigerant charging, lubrication, oil draining and general working clearance. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

B. Rooftop Air Conditioning Units: Install system as indicated, in accordance with the requirements of ASHRAE 15, and as recommended in the manufacturer's installation and operational instructions.
   1. Ductwork: Provide in accordance with Specification Section 23 31 13, “Ductwork and Ductwork Accessories”.
   2. Condensate Drain: Furnish and install external condensate drain piping and traps where required.
   3. Natural gas piping, connections, valves and accessories shall be furnished and installed in accordance with Section 23 11 23, “Fuel Gas Piping”.

C. Electrical Work: Electric motor-driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with Division 26-Electrical. Provide manual or automatic control and protective devices required for the operation herein specified and any control wiring (120V or less) required for controls and devices but not indicated.

D. Access Panels: Provide access panels for all concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

E. Air Filters: Install air filters to allow access space for servicing the filters. Install filters with suitable sealing to prevent bypassing of air.

3.02 TESTING AND COMMISSIONING

A. Tests: All tests shall be performed by and everything required for test shall be furnished by the Contractor, including personnel. Equipment and materials certified as having been successfully tested by the manufacturer in accordance with referenced specifications and standards will not require retesting before installation. Equipment and materials not tested at the place of manufacture shall be tested before or after installation, as applicable, where necessary to determine compliance with referenced specifications and standards.
   1. Prior to initial operation, inspect equipment installation for conformance with drawings and specifications. After preliminary tests and inspections, test, adjust and balance the air handling and distribution equipment in accordance with Section 23 05 93, “Testing and Balancing Air and Water Systems”.
   2. Leak Testing: Upon completion of installation of the air conditioning equipment, test all factory- and field-installed refrigerant piping with an electronic-type leak detector to acquire a leak-tight refrigerant system. If leaks are detected at time of installation or during the guarantee period, remove the entire refrigerant charge from the system, correct the leaks, and retest the system.

3. Evacuation, Dehydration, and Charging: After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gage and a vacuum pump capable of pulling a vacuum of at least 1 mm Hg absolute. Evacuate system in accordance with the triple-evacuation and blotter method or, in accordance with equipment manufacturer's printed instructions. System leak testing, evacuation, dehydration, and charging with refrigerant shall comply with the requirements contained in AHRI 260.
4. Startup and Operation Tests: Test the air conditioning systems and systems components for proper operation. Adjust safety and automatic control instruments as necessary to insure proper operation and sequence. The operational test shall be not less than 8 hours.

3.03 INSTRUCTION OF OPERATING PERSONNEL

A. Upon completion of the work, and acceptance of the installation, and at a time designated by the Owner, the services of a competent technician regularly employed or authorized by the manufacturer of the compactor shall be provided for instructing personnel in the proper operation, maintenance, safety and emergency procedures. The period of instruction shall be not less than two hours. The training shall be conducted at the job site during actual operation and coordinated with the Owner one week in advance.

END OF SECTION

SECTION 26 05 01

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Electrical General Requirements, as shown on the Plans, as specified and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Federal Specification (Fed. Spec.):
      a. L-P-387A - Plastic Sheet, Laminated, Thermosetting (for Design Plates)
   2. American National Standards Institute (ANSI) Publications:
      a. C37.20 - Switchgear Assemblies, Including Metal-Enclosed Bus
      b. Z35.1 - Accident Prevention Signs
   3. Institute of Electrical and Electronics Engineers (IEEE) Publication:
      a. 100 - Standard Dictionary of Electrical and Electronics Terms
   4. National Electrical Manufacturers Association (NEMA) Publication:
      a. ICS 6 - Enclosures for Industrial Controls and Systems
   5. National Fire Protection Association (NFPA) Publications:
      a. 70B - Electrical Equipment Maintenance
      b. 70 - National Electrical Code

1.03 APPLICATION

A. This Section applies to all sections of Division 26, "Electrical", of this project except as specified otherwise in each individual section.

1.04 DEFINITION OF ELECTRICAL TERMS

A. Unless otherwise specified or indicated, electrical terms used in these Specifications, and on the drawings, shall be as defined in IEEE Standard No. 100.

1.05 ELECTRICAL UTILITY COORDINATION & ELECTRICAL SYSTEM VERIFICATION

A. Contractor shall coordinate all pre and post construction activities with the Electrical Utility Central Hudson Gas and Electric provider per the EUs written bulletin/specification requirements.

B. Prior to shop drawing submittals, prior to commencing any demolition and/or prior to commencing any new construction activities, electrical characteristics for all existing and/or proposed electrical systems (including service, premises wiring systems and/or separately derived systems) shall be verified by this Contractor.

C. The Contractor shall coordinate and confirm, in writing, the following information from the Electrical Utility prior to commencement of any work under this Contract:
   1. Voltage
   2. Number of phases
   3. Type of system grounding
   4. Metering arrangement and Style
   5. Electrical Service Capacity
   6. System impedances and available fault current at point of common coupling (PCC)

D. Should the Contractor’s verification of any existing or proposed electrical system indicate a discrepancy with the Contract Documents, report them immediately to the Owner and/or Owners designated representative.

E. Submitting shop drawings and/or commencing any work under this Contract prior to all electrical systems verification/confirmation as required above signifies that Contractor accepts all existing and proposed electrical system characteristics and conditions.

1.06 SUBMITTALS

A. Obtain approval before procurement, fabrication, or delivery of items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable Federal, Military, industry, and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished. Furnish a minimum of six (6) copies of shop drawings for each major device specified or electronic shop drawings as specified herein. All hard copy shop drawings shall be a minimum of 8.5 inches by 11 inches in size.

B. Shop Drawings: In addition to the requirements specified elsewhere, shop drawings shall meet the following requirements. Drawings shall include complete ratings information, wiring diagrams, and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.

C. Manufacturer's Data: Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

D. Publication Compliance: Where equipment or materials are specified to conform to industry and technical society publications of organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters' Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In lieu of the label or listing, submit a certificate from an approved independent testing organization, adequately equipped and competent to perform such services, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publication.

E. Submittals Required: Supply shop drawing submittal information as otherwise noted in each individual section.

F. Electronic Shop Drawings: If allowed by other sections of these Contract Documents, electronic submittals shall be submitted to Engineer in accordance with procedures outlined in these Contract Documents, as established at a preconstruction meeting and/or per Engineer’s written instructions.

1. Electronic shop drawings shall be submitted in an OCR (searchable) PDF file format or per Engineer’s instructions. Each shop drawing shall be a single electronic file with correct orientation of all sheets contained within.
2. Electronic shop drawings shall be scaled to print at 8.5 inches by 11 inches (for general information, manufacturer’s product data, etc.) and as required for drawings (layout drawings, coordination drawings, schematics, site drawings, electronic copy), except as specified otherwise.
3. Engineer shall make final determination on clarity of electronic shop drawings and will reject electronic shop drawing if resolution is not acceptable.

1.07 OPERATION AND MAINTENANCE MANUAL

A. Submit as required for systems and equipment indicated in the technical sections. Furnish 3 copies, bound in hardback binders or an approved equivalent. Furnish one complete manual prior to performance of systems or equipment tests, and furnish the remaining manuals prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL", the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment. Include a table of contents and assemble the manual to conform to the table of contents, with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include:

1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment.
2. A control sequence describing startup, operation, and shutdown.
3. Description of the function of each principal item of equipment.
4. Installation and maintenance instructions.
5. Safety precautions.
6. Diagrams and illustrations.
7. Testing methods.
8. Performance data.
   Lubrication schedule including type, grade, temperature range, and frequency.
9. Parts list. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
10. Appendix: List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

B. Electronic Version: Provide a complete O&M as a single PDF file, or multiple files if there are significant amounts of data. PDF file(s) shall be an optical character recognition (OCR) or searchable file.

1.08 SPARE PARTS

A. Provide spare parts for all equipment installed under this Contract, as indicated in individual specification sections.

1.09 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic.

Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.10 INSTRUCTION TO OWNER'S PERSONNEL

A. Where indicated in the technical sections, furnish the services of competent instructors to give full instruction to Owner's personnel in the adjustment, operation, and maintenance of systems and equipment, including pertinent safety requirements as required. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The number of man days (8 hours) of instruction furnished shall be as specified in each individual section.

1.11 LAYOUT OF THE WORK

A. Coordinate the proper relation of the work to the building structure, existing utilities and to the work of all trades. Visit the premises and become familiar with the dimensions in the field, and advise the Owner's Representative of any discrepancy before performing any work.
   1. Contract Drawings: The Contract Drawings represent the general intent as to layout and equipment arrangements. All locations and dimensions shown shall be field verified and minor alterations made if so required. Where dimensions are not given for the location and arrangement of mechanical systems, locations may be assumed to be approximate, and may be altered if required. Major modifications to the indicated arrangements shall be approved by the Owner's Representative prior to the installation of mechanical systems. Schematic diagrams represent the overall system requirements and do not necessarily indicate the physical orientation, location or dimensions of that system.
   2. Record Drawings: The Contractor shall maintain a record of the progress of the work and shall submit three (3) hard copy sets of As-Built Drawings upon completion of the project.

1.12 DELIVERY AND STORAGE

A. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B, Appendix I, titled "Equipment Storage and Maintenance During Construction". Replace damaged or defective items with new items.

1.13 SPECIAL CONDITIONS

A. When performing work within active areas, the Contractor shall be responsible to coordinate with the Owner regarding planned interruptions to electrical services and/or road access. Contractor must maintain in service the existing electrical services at the existing Federal Court House unless otherwise coordinated with the Owner.

B. Protection of Existing Work: The Contractor shall take all necessary precautions to ensure against damage to existing work to remain in place, or to be reused. The Contractor shall ensure that structural elements are not overloaded and additional structural supports required as a result of any cutting, removal or demolition work performed under any part of this Contract are added. Unless specified otherwise, the Contractor shall submit for review detailed shop drawings applicable to the Contract work for all structural supports, hangers and related devices, structural modifications, temporary rigging and associated rigging plans. Commencement of such work prior to the submission and review of applicable shop drawings shall be at the sole risk of the Contractor.

C. Upon damage to existing equipment, buildings, and/or structures, the Contractor shall immediately notify the Owner. All damages shall be repaired by the Contractor, or shall be replaced if beyond repair, to match the existing to the Owner's satisfaction.

D. Protection of Buildings from the Weather: The interior of the buildings and all materials and equipment shall be protected from the weather at all times.

E. Protection of Personnel: Where the safety of non-contractor personnel is endangered in the area of the work, barricades shall be used. Additional protection shall be provided if required, to preserve the safety of non-contractor personnel in the immediate area of the work.

F. Contractor shall maintain open road access at all times to the existing Federal Court House. Contractor shall stage construction such that at least one lane of the existing access road is open at all times. Contractor shall coordinate with the Owner a minimum of one week prior to any planned road closings.

G. Construction in Existing Buildings: Verify with Owner expected routing of new wire and/or conduit within existing equipment or buildings prior to field construction of systems. Coordinate with the Owner a minimum of ten (10) working days prior to any planned disruption of existing working systems.

1.14 CATALOGED PRODUCTS/SERVICE AVAILABILITY

A. Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The

2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The 2-year period shall be satisfactorily completed by a product for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the Contract.

1.15 MANUFACTURER'S RECOMMENDATIONS

A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material. Obtain manufacturer's recommendations from the Owner for equipment and/or material provided by the Owner.

1.16 MOTORS AND MOTOR CONTROLS FOR MECHANICAL EQUIPMENT

A. The electrical components of mechanical equipment, such as motors, motor starters, control or push button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, and control wiring and conduit for circuits rated 100 volts or less, are specified in the section covering the associated mechanical equipment, rather than in Division 26, unless otherwise shown. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits shall be furnished and installed under Division 26 in accordance with other sections and/or as shown on the Contract Drawings.

1.17 ARC FLASH HAZARD ANALYSIS

A. Unless specified elsewhere in these Contract Documents, provide arc-flash analysis and labels on all Contractor provided and/or installed: switchboards, panelboards, meter trough’s MCCs, motor controllers and disconnects.

B. The ARC flash hazard analysis shall provide the following system information: System voltage, hazard and risk category, flash protection boundary, shock approach boundaries, required level of pipe, equipment ID, and date of assessment. Table 130.7(c)(15)(a) and 130.7(c)(15)(b) from NFPA 70E (most recent addition) to be utilized as applicable.

C. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-LATEST EDITION, Annex D.

D. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

E. The Arc-Flash Hazard Analysis shall include all significant locations from service entrance gear down to and including 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

F. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm^2.

G. When appropriate, the short-circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

H. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

I. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
   1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
   2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

J. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

K. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

L. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

M. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 Section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

N. Provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed. Labels affixed to equipment enclosures rated NEMA 3R, 4, 4X, 6, or 8 shall be rated for outdoor use.

O. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

P. The label shall include the following information, at a minimum:
1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy (new distribution equipment only)
6. Working distance
7. Engineering report number, revision number and issue date.

Q. Labels shall be machine printed, with no field markings.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. All materials, equipment, and devices shall, as a minimum, meet the requirements of UL where UL standards are established for those items, and the requirements of NFPA 70. All items shall be new unless specified or indicated otherwise.

2.02 NAMEPLATES

A. Fed. Spec. L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the black core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be a minimum of 0.25-inch high normal block style.

B. For sites with power generation equipment: Provide permanent nameplate at service entrance equipment indicating type and location of on-site generation power source (generator, PV, co-gen, etc.) in accordance with NEC Article 705. Provide same nameplate at generation sources main disconnect indication type and location of service entrance equipment.

PART 3 - EXECUTION

3.01 NAMEPLATE MOUNTING

A. Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

B. Provide nameplates for all equipment as required by other sections.

C. Provide nameplates for all owner furnished equipment that is installed by this Contractor.

3.02 PAINTING OF EQUIPMENT

A. Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.

3.03 TESTS

A. General: Perform and record all tests in the presence of the Owner's authorized representative and/or the Engineer. Furnish all instruments and personnel. Perform preliminary tests and correct all defective material and/or workmanship prior to witness of tests. Perform tests as indicated and as otherwise noted in other Sections of the Division 26.

B. Conduct field tests in the sequence listed below:

1. Insulation Resistance Tests: As required per individual specification sections.

C. Load Balance Test: Make test by energizing all lighting, motors and other electrical equipment simultaneously for a three-hour period. Alter fuses, circuit breakers, circuit connections, etc., as required for satisfactory performance. Take voltage and amperage readings on each circuit at all panels.

D. Check the amperage draw, voltage and direction of rotation of each motor in the presence of the equipment contractor and the Owner's representative. Make all necessary changes to obtain proper rotation, motor terminal voltage, motor protection, etc. Revise heater elements as necessary for proper motor protection. Similarly check all other electrically connected equipment.
1. Make the test at a time during the day or night that is mutually satisfactory to the Owner at least one week prior to substantial completion. Make all arrangements and notify all parties in writing at least seventy-two hours prior to the test.

E. Equipment Operation Test - Show by demonstration in service that all circuits are in good operating condition. Cycle all control equipment under load at least five times.

F. Equipment and apparatus factory tests - Manufacturer's normal quality control tests are acceptable, unless specific factory witnessed tests are specified in other sections.

G. Perform all other field tests as required in individual specification sections.

3.04 CLEANING

A. When directed, just prior to final acceptance, clean all equipment including, but not limited to, the following:
1. Lighting fixtures, panelboards, control centers, switchgear, receptacles and switch plates - Remove all tags and labels; leave ready for use
2. All equipment to be painted, removing all rust, etc., and leave ready for painting
3. Building, by removing all debris, conduits, wire, insulation, cartons, etc., left as a result of this work.

3.05 THIRD PARTY INSPECTION AND MISC SERVICES COORDINATION

A. Contractor shall provide and pay for inspection of electrical work by an AHJ approved electrical inspection agency.

B. Contractor shall coordinate with the Owner and the Telephone Company regarding telephone service requirements and connection.

C. Contractor shall coordinate with the Owner and the Internet Provider regarding telephone service requirements and connection.

D. Contractor shall coordinate with the Owner regarding connections to existing systems and work within existing buildings and equipment.

3.06 WORK WITHIN EXISTING BUILDINGS

A. Contractor shall install new feeder breakers in existing panels and shall install new conduit and wire systems within existing buildings. Contractor shall use care in installation of new work and shall protect existing work and finishes in his work area. Contractor shall immediately notify Owner of any damages to existing equipment or finishes and shall restore damaged items to Owner's satisfaction.

END OF SECTION

SECTION 26 05 19

WIRING/CABLE, 600 VOLTS AND UNDER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials, equipment and accessories for Wiring/Cable, 600 Volts and Under, as shown on the Plans, as specified and/or directed.

B. For type MC cable, refer to Contract Drawings for areas where MC cable is allowed. MC cable shall be allowed only for branch circuit wiring (lighting and receptacles).

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only and shall be the most current version.
   1. National Electrical Manufacturers Association (NECA) Publication:
      a. Standard of Installation
   2. International Electrical Testing Association (NETA) Publication:
      a. ATS - Electrical Power Distribution Equipment and Systems
   3. National Fire Protection Association (NFPA) Publication:
      a. 70 - National Electrical Code
   4. American Society for Testing and Materials (ASTM) Publications:
      a. B1 - Hard-Drawn Copper Wire
      b. B8 - Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
      c. E14 - Fire Tests of Through-Penetration Fire Stops
   5. Underwriters Laboratories, Inc. (UL) Publications:
      a. 854 - Service Entrance Cables
      b. 486A - Wire Connector and Soldering Lugs for Use with Copper Conductors
      c. 486C - Splicing Wiring Connectors
      d. 1569 - Metal-Clad Cables

1.03 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

B. Specification required test results.

1.04 PRODUCT DELIVERY

A. Mark and tag insulated conductors and cables for delivery to the site. Include:
   1. Contractor's name.
   2. Project title and number.
   3. Date of manufacture (month & year).
   4. Manufacturer's name.
   5. Environmental suitability information (listed or marked "sunlight resistant" where exposed to direct rays of sun; wet locations listed/marked for use in wet locations; other applications listed/marked suitable for the applications).

PART 2 - PRODUCTS

2.01 INSULATED CONDUCTORS AND CABLES

A. Date of Manufacture: No insulated conductor more than one year old when delivered to the site will be acceptable.

B. Acceptable Companies: American Insulated Wire Corp., BICC General Cable Industries, Inc., Cerro Wire & Cable Co. Inc., Pirelli Cable Corp., Owl Cable Corp., or Southwire Co.

C. Conductors: Annealed uncoated copper or annealed coated copper in conformance with the applicable standards for the type of insulation to be applied on the conductor. Conductor sizes No. 12 and larger shall be stranded.

D. Types:
   1. Lighting and Power Wiring:
      a. Insulation: Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THW, THWN, XHHW, or RHW, except that grounding wire may be Type TW. Where lighting fixtures require 90-degree C conductors, provide only conductors with 90-degree C insulation or better.
      b. Metal-Clad Cable, NFPA 70 Article 334 Type MC:
      c. Interlocked flexible galvanized steel armor sheath, conforming to UL requirements for type MC metal clad cable.
      d. Insulated copper conductors, suitable for 600 volts, rated 90°C, one of the types listed in NFPA 70 Table 310-13 or of a type identified for use in Type MC cable.
      e. Internal full size copper ground conductor with green insulation.
      f. Acceptable Companies: AFC Cable Systems Inc., Coleman Cable Co.

g. Connectors for MC cable: AFC Fitting Inc.'s AFC Series, Arlington Industries Inc.'s Saddle grip, or Thomas & Betts Co.'s Tite-Bite with anti-short bushings.

1) MI: AFC Cable Systems' Type MI Cable, or BICC/Pyrotenax Mineral Insulated System 1850 Pyrotenax Cable:

a) Copper conductors.

b) Sheathing containing asbestos fibers shall not be used.

In corrosive areas where indicated on drawings, utilize the following:

c) PVC or HDPE jacketing (where shown on drawings).

d) 600 volt rating.

e) Fittings and accessories as required for a complete system to suit listing and installation conditions.

2. Class 1, 2, 3 Wiring: Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; and for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.

3. VFD Cables: VFD equipment shall be wired from line side (for standalone VFDs) and load side of VFD (standalone VFDs and MCC VFDs) to motor utilizing VFD rated cable. Cable specifications are as follows:

a. 600V UL 1277 Type TC per 2005 NEC Article 336
b. Copper Conductors
c. Class B Stranding per ASTM
d. XLPE Insulation XHHW-2 Rated Circuit Conductors (14 AWG and larger)
e. 90°C Wet/Dry
f. Class I & II; Division 2 Hazardous Locations
g. Overall UL 1685 Vertical Tray Flame Test
h. IEEE 1202/383 Vertical Tray Flame Test
i. Overall Shield

2.02 CONNECTORS

A. General:

1. Connectors specified are part of a system. Furnish connectors and components, and use specific tools and methods as recommended by connector manufacturer to form complete connector system.
2. Connectors shall be capable of continuous operation at the current rating of the cables on which they are used.
3. Connectors shall be UL 486 A listed, or UL 486 B listed for combination dual rated copper/aluminum connectors (marked AL7CU for 75 degrees C rated circuits and AL9CU for 90 degrees C rated circuits).

B. Splices:
   1. Spring Type:
      a. Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s B-Cap, Electrical Products Div./3M's Scotchlok Type Y, R, G, B, O/B+, R/Y+, or B/G+, or Ideal Industries Inc.'s Wing Nuts or Wire Nuts.
      b. Rated 150° C, 600V; Ideal Industries Inc.'s High Temperature Wire-Nut Model 73B, 59B.
   2. Indent Type with Insulating Jacket: Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s Crimp Connectors, Ideal Industries Inc.'s Crimp Connectors, Penn-Union Corp.'s Penn-Crimps, or Thomas & Betts Corp.'s STA-KON.
   3. Indent Type (Uninsulated): Anderson/Hubbell's Versa-Crimp, VERSAtile, Blackburn/T&B Corp.'s Color-Coded Compression Connectors, Electrical Products Div./3M's Scotchlok 10000, 11000 Series, Framatome Connectors/Burndy's Hydent, Penn-Union Corp.'s BCU, BBCU Series, or Thomas & Betts Corp.'s Compression Connectors.
   4. Connector Blocks: NIS Industries Inc.'s Polaris System, or Thomas & Betts Corp.'s Blackburn AMT Series.
   5. Resin Splice Kits: Electrical Products Div./3M's Scotchcast Brand Kit Nos. 82A Series, 82-B1 or 90-B1, or Scotchcast Brand Resin Pressure Splicing Method.
   6. Heat Shrinkable Splices: Electrical Products Div./3M's ITCSN, Raychem Corp.'s Thermofit Type WCS, or Thomas & Betts Corp.'s SHRINK-KON Insulators.
   7. Cold Shrink Splices: Electrical Products Div./3M's 8420 Series.

C. Gutter Taps: Anderson/Hubbell's GP/GT with GTC Series Covers, Blackburn/T&B Corp.'s H-Tap Type CF with Type C Covers, Framatome Connectors/Burndy's Polytap KPU-AC, H-Crimpit Type YH with CF-FR Series Covers, ILSCO's GTA Series with GTC Series Covers, Ideal Industries Inc.'s Power-Connect GP, GT Series with GIC covers, NSI Industries Inc.'s Polaris System, OZ/Gedney Co.'s PMX or PT with PMXC, PTC Covers, Penn-Union Corp.'s CDT Series, or Thomas & Betts Corp.'s Color-Keyed H Tap CHT with HTC Covers.

D. Terminals: Nylon insulated pressure terminal connectors by Amp-Tyco/Electronics, Electrical Products Div./3M, Framatome Connectors/Burndy, Ideal Industries Inc., Panduit Corp., Penn-Union Corp., Thomas & Betts Corp., or Wiremold Co.

E. Lugs:
   1. Single Cable (Compression Type Lugs): Copper, 1 or 2 hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Framatome Connectors/Burndy's Hylug YA, Electrical Products Div./3M Scotchlok 31036 or 31145 Series, Ideal Industries Inc.'s CCB or CCBL, NSI Industries Inc.'s L, LN Series, Penn-Union Corp.'s BBLU Series, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.
   2. Single Cable (Mechanical Type Lugs): Copper, one or 2 hole style (to suit conditions); Blackburn/T&B Corp.'s Color-Keyed Locktite Series, Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Locktite Series.
   3. Multiple Cable (Mechanical Type Lugs): Copper, configuration to suit conditions; Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Color-Keyed Locktite Series.

2.03 TAPES

A. Insulation Tapes:
   1. Plastic Tape: Electrical Products Div./3M's Scotch Super 33+ or Scotch 88, Plymouth Rubber Co.'s Plymouth/ Bishop Premium 85CW.
   2. Rubber Tape: Electrical Products Div./3M's Scotch 130C, or Plymouth Rubber Co.'s Plymouth/Bishop W963 Plysafe.

B. Moisture Sealing Tape: Electrical Products Div./3M's Scotch 2200 or 2210, or Plymouth Rubber Co.'s Plymouth/Bishop 4000 Plyseal-V.

C. Electrical Filler Tape: Electrical Products Div./3M's Scotchfil, or Plymouth Rubber Co.'s Plymouth/Bishop 125 Electrical Filler Tape.

D. Color Coding Tape: Electrical Products Div./3M's Scotch 35, or Plymouth Rubber Co.'s Plymouth/Bishop Premium 37 Color Coding.

E. Arc Proofing Tapes:
   1. Arc Proofing Tape: Electrical Products Div./3M's Scotch 77, Mac Products Inc.'s AP Series, or Plymouth Rubber Co.'s Plymouth/Bishop 53 Plyarc.
   2. Glass Cloth Tape: Electrical Products Div./3M's Scotch 27/Scotch 69, Mac Products Inc.'s TAPGLA 5066,, or Plymouth Rubber Co.'s Plymouth/Bishop 77 Plyglas.
   3. Glass-Fiber Cord: Mac Products Inc.'s MAC 0527.

2.04 WIRE-PULLING COMPOUNDS

A. To suit type of insulation; American Polywater Corp.'s Polywater Series, Electric Products Div./3M's WL, WLX, or WLW, Greenlee Textron Inc.'s Y-ER-EAS, Cable Cream, Cable Gel, Winter Gel, Ideal Industries Inc.'s Yellow 77, Aqua-Gel II, Agua-Gel CW, or Thomas & Betts Corp.'s Series 15-230 Cable Pulling Lubricants, or Series 15-631 Wire Slick.

2.05 TAGS

A. Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inch high.

B. Phenolic: Two color laminated engraver's stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).

C. Aluminum: Standard aluminum alloy plate stock, minimum .032 inch thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.

2.06 WIRE MANAGEMENT PRODUCTS

A. Cable Clamps and Clips, Cable Ties, Spiral Wraps, etc: Catamount/T&B Corp., or Ideal Industries Inc.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install conductors in raceways after the raceway system is completed. Exceptions: Type TC, MI, or other type specifically indicated on the drawings not to be installed in raceways.

B. No grease, oil, or lubricant other than wire-pulling compounds specified may be used to facilitate the installation of conductors. Completely and thoroughly swab raceway/wire before installing wire/cable.

C. All splices and connections shall be made in accessible boxes and cabinets only.

3.02 CIRCUITING

A. Wiring and cables of different systems shall not be run in same raceway. Power wiring shall not be run in same raceway for remote control/signal wiring.

B. Class 2, 3 plenum rated cables shall be run without raceway when concealed above accessible ceilings unless otherwise indicated on Contract Drawings. These cables shall be run parallel and perpendicular to building surfaces, and shall be neatly bundled and shall be supported independently from the accessible ceiling utilizing bridle rings or similar. Cables shall effectively be routed horizontal. Provide conduit sleeves at wall penetrations.

3.03 COMMON NEUTRAL CONDUCTOR

A. A common neutral shall not be used. Provide individual neutral per each circuit.

3.04 COLOR CODING

A. Color Coding for 120/208/240 Volt Electric Light and Power Wiring:
   1. Color Code:
      a. 2 wire circuit - black, white.
      b. 3 wire circuit - black, red, white.
      c. 4 wire circuit - black, red, blue, white.
   2. White to be used only for an insulated grounded conductor (neutral). If neutral is not required use black and red, or black, red and blue for phase to phase circuits.
      a. "White" for Sizes No. 6 AWG or Smaller:
         1) Continuous white outer finish, or:
         2) Three continuous white stripes on other than green insulation along its continuous length.
      b. "White" for Sizes Larger Than No. 6 AWG:
         1) Continuous white outer finish, or:
         2) Three continuous white stripes on other than green insulation along its continuous length, or:
         3) Distinctive white markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install white color coding tape at terminations, and at 1' 0" intervals in gutters, pull boxes, and manholes.
   3. Colors (Black, Red, Blue):
      a. For Branch Circuits: Continuous color outer finish.
      b. For Feeders:
         1) Continuous color outer finish, or:
         2) Color coding tapes encircling the conductors, installed on the conductors at time of their installation. Install color coding tapes at terminations, and at 1' 0" intervals in gutter, pull boxes, and manholes.

B. Color Coding For 277/480 Volt Electric Light and Power Wiring:
   1. Color Code:
      a. 2 wire circuit – brown, gray.
      b. 3 wire circuit – brown, yellow, gray.
      c. 4 wire circuit – brown, orange, yellow, gray.
   2. Gray to be used only for an insulated grounded conductor (neutral). If neutral is not required use brown and yellow, or brown, yellow and orange for phase to phase circuits.
      a. "Gray" For Sizes No. 6 AWG or Smaller:
         1) Continuous gray outer finish.
      b. "Gray" For Sizes Larger Than No. 6 AWG:
         1) Distinctive gray markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install gray color coding tape at terminations, and at 1' 0" intervals in gutters, pull boxes, and manholes.
      c. Colors (Brown, Yellow, Orange):
      d. For Branch Circuits: Continuous color outer finish.
      e. For Feeders:
         1) Continuous color outer finish, or:
         2) Color coding tapes encircling the conductors, installed on the conductors at the time of their installation. Install color coding tapes at terminations, and at 1' 0" intervals in gutters, pull boxes, and manholes.

C. More Than One Nominal Voltage System Within A building: Permanently post the color coding scheme at each branch-circuit panelboard.

D. Existing Color Coding Scheme: Where an existing color coding scheme is in use, match the existing color coding if it is in accordance with the requirements of NFPA 70.

E. Color Code For Wiring Other Than Light and Power: In accordance with ICEA/NEMA WC-30 "Color Coding of Wires and Cables". Other coding methods may be used, as approved.

F. On 3-phase, 4-wire delta system, high leg shall be orange, as required by NFPA 70.

3.05 IDENTIFICATION

A. Identification Tags: Use tags to identify feeders and designated circuits. Install tags so that they are easily read without moving adjacent feeders or requiring removal of arc proofing tapes. Attach tags with non-ferrous wire or brass chain.
   1. Interior Feeders: Identify each feeder in pull boxes and gutters. Identify by feeder number and size.

2. Exterior Feeders: Identify each feeder in manholes and in interior pull boxes and gutters. Identify by feeder number and size, and also indicate building number and panel designation from which feeder originates.
3. Street and Grounds Lighting Circuits: Identify each circuit in manholes and lighting standard bases. Identify by circuit number and size, and also indicate building number and panel designation from which circuit originates.

B. Identification Plaque: Where a building or structure is supplied by more than one service, or has any combination of feeders, branch circuits, or services passing through it, install a permanent plaque or directory at each service, feeder and branch circuit disconnect location denoting all other services, feeders, or branch circuits supplying that building or structure or passing through that building or structure and the area served by each.

C. All control conductors as specified herein shall be labeled at each termination point. Labeling shall be permanently labeled with printed Brady type labels or equivalent.

3.06 WIRE MANAGEMENT

A. Use wire management products to bundle, route, and support wiring in junction boxes, pull boxes, wireways, gutters, channels, and other locations where wiring is accessible.

3.07 EQUIPMENT GROUNDING CONDUCTOR

A. Install Equipment Grounding Conductor:
1. Where specified in other Sections or indicated on the Contract Drawings.
2. In conjunction with circuits recommended by equipment manufacturers to have equipment grounding conductor.

B. Equipment grounding conductor is not intended as a current carrying conductor under normal operating circumstances.

C. Color Coding For Equipment Grounding Conductor:
1. Color Code: Green.
2. "Green" For sizes No. 6 AWG or Smaller:
   a. Continuous green outer finish, or:
   b. Continuous green outer finish with one or more yellow stripes, or:
   c. Bare copper (see exception below).
3. "Green" For Sizes Larger Than No. 6:
   a. Stripping the insulation or covering from the entire exposed length (see exception below).

b. Marking the exposed insulation or covering with green color coding tapes.
c. Identify at each end and at every point where the equipment grounding conductor is accessible.

4. Exception For use of Bare Copper: Not allowed for use where NFPA 70 specifically requires equipment grounding conductor to be insulated, or where specified in other sections or indicated on the drawings to be insulated.

3.08 SPECIAL GROUNDING CONDUCTORS

A. Technical Power System Grounding (Equipment grounding conductor isolated from the premises grounded conductor except at a single grounded termination point): Install an insulated grounding conductor running with the circuit conductors for isolated receptacles or utilization equipment requiring an isolated ground.
1. Color Code: Green.
2. "Green" For Isolated Grounding Conductor:
a. Continuous green outer finish, or:
b. Continuous green outer finish with one or more yellow stripes, and:
c. Different than the "green" used for the equipment grounding conductor run with the circuit (where required).
3. Install label at every point where the conductor is accessible, identifying it as an "Isolated Grounding Conductor".

3.09 ARC PROOFING

A. Arc proof 600V and under cables only where routed in a manhole/handhole that also contains medium voltage cable/feeders as follows:
1. Arc proof new 600V and under cables.
2. Arc proof existing 600V and under cables that are spliced to new 600V and under cables.
3. Arc proof each 600V and under cable as a unit (except cables consisting of multiple sets of conductors).
4. Arc proof 600V and under cables consisting of multiple sets of conductors by arc proofing each set of conductors as a unit.
5. Arc proof with half-lapped layer of 55 mils thick arc proofing tape and random wrapped or laced with glass cloth tape or glass-fiber cord. For arc proofing tape less than 55 mils thick, add layers to equivalent of 55 mils thick arc proofing tape.

3.10 INSULATED CONDUCTOR AND CABLE SCHEDULE - TYPES AND USE

A. Electric Light and Power Circuits:

1. FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, or XHHW-2: Wiring in dry or damp locations (except where special type insulation is required).
2. THWN, THWN-2, XHHW, XHHW-2, USE, or USE-2: Wiring in wet locations (except where type USE or USE-2 insulated conductors are specifically required, or special type insulation is required).
3. THHN, THWN or THWN-2: Wiring installed in existing raceway systems (except where special type insulation is required).
4. THHN, THW-2, THWN-2, XHHW, or XHHW-2: Wiring for electric discharge lighting circuits (fluorescent, HID), except where fixture listing requires wiring rated higher than 90° C.
5. THWN Marked “Gasoline and Oil Resistant”: Wiring to gasoline and fuel oil pumps.
6. USE, or USE-2: Wiring indicated on the drawings to be direct burial in earth.
7. USE, or USE-2 Marked “Sunlight Resistant”:
   a. Service entrance wiring from overhead service to the service equipment.
   b. Wiring exposed to the weather and unprotected (except where special type insulation is required).
8. MC: Where allowed for 120V, 20A max circuits per the Contract Drawings or part as specified herein:
   a. Branch circuit wiring in wood framed construction (wood joists and wood stud partitions):
      1) Install conductors parallel with joists or studs and attach to the side of these timbers by galvanized straps spaced not more than 6 feet apart.
      2) Install conductors through holes bored in the center of the timbers when running at right angles to joists or studs.
      3) Do not attach the conductors to the edge of joists or studs.
   b. Branch circuit wiring in movable metal partitions and movable gypsum partitions.
      1) Install conductors in accordance with partition manufacturer’s recommendations.
   c. Branch circuit wiring in metal stud partitions:
      1) Install conductors parallel with studs and attach to the side by galvanized straps spaced not more than 6 feet apart.
      2) Install conductors through holes bored in the center of the metal member when running at right angles to studs.
   d. Conductors shall be protected by listed bushings or listed grommets covering all metal edges.
      1) Do not attach the conductors to the edge of studs.

9. MI:
    a. Wiring for underplaster extensions.
    b. Wiring in areas where indicated on the Contract Drawings.
    c. Where MI cable is installed in areas subjecting cable to corrosion, use PVC or HDPE jacketed MI cable (nonmetallic jacketed cable is not suitable for use in ducts, plenums or other spaces used for environmental air).

B. Emergency Feeder Circuits: Use electrical circuit protective system.

C. Class 1 Circuits: Use Class 1 wiring specified in Part 2 (except where special type insulation is required).

D. Class 2 Circuits: Use Class 2 wiring specified in Part 2 (except where special type insulation is required).

E. Class 3 Circuits: Use Class 3 wiring specified in Part 2 (except where special type insulation is required).

3.11 CONNECTOR SCHEDULE - TYPES AND USE

A. Temperature Rating: Use connectors that have a temperature rating, equal to, or greater than the temperature rating of the conductors to which they are connected.

B. Splices:
1. Dry Locations:
    a. For Conductors No. 8 AWG or Smaller: Use spring type pressure connectors, indent type pressure connectors with insulating jackets, or connector blocks (except where special type splices are required).
    b. For Conductors No. 6 AWG or Larger: Use connector blocks or uninsulated indent type pressure connectors. Fill indentions in uninsulated connectors with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with heat shrinkable splices or cold shrink splices.
    c. Gutter Taps in Panelboards: For uninsulated type gutter taps fill indentions with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with gutter tap cover.
2. Damp Locations: As specified for dry locations, except apply moisture sealing tape over the entire insulated connection (moisture sealing tape not required if heat shrinkable splices or cold shrink splices are used).
3. Wet Locations: Use uninsulated indent type pressure connectors and insulate with resin splice kits, cold shrink splices or heat shrinkable splices. Exception: Splices aboveground which are totally enclosed and protected in NEMA 3R, 4, 4X enclosures may be spliced as specified for damp locations.

C. Terminations:

1. For Conductors No. 10 AWG or Smaller: Use terminals for:
   a. Connecting wiring to equipment designed for use with terminals.
2. For Conductors No. 8 AWG or Larger: Use compression or mechanical type lugs for:
   a. Connecting cables to flat bus bars.
   b. Connecting cables to equipment designed for use with lugs.
3. For Conductor Sizes Larger Than Terminal Capacity On Equipment: Reduce the larger conductor to the maximum conductor size that terminal can accommodate (reduced section not longer than one foot). Use compression or mechanical type connectors suitable for reducing connection.

3.12 TESTING

A. Insulation Resistance Tests: Make tests after all wiring is completed and connected ready for the attachment of fixture and/or equipment. Repeat test when all fixtures and/or equipment are connected ready for use. Make tests with an instrument capable of measuring the resistance involved at a voltage of at least 500 VDC for equipment rated at 100 to 500 VAC, 1500 VDC for equipment rated at 151 to 600 VAC. Apply voltage continuously for one minute prior to taking reading. Measure insulation resistance between each pair of insulated conductor separately and between each insulated conductor and ground. Make tests at each panelboard distribution panel, and switchboard on every circuit with the circuit protective device open but connected. The minimum acceptable measured insulation resistance for wiring completed and ready for connection of fixtures and/or equipment is 50 meg ohms.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Grounding and bonding of electrical installations as shown on the Plans, as specified and/or directed.

B. Existing site conditions may necessitate use of alternative grounding systems to achieve required ohm values. Existing site conditions are to include minimum soil cover over bedrock and exposed bedrock.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American National Standards Institute (ANSI), Electronic Industries Alliance (EIA), Telecommunications Industry Association (TIA) Publication: (ANSI/EIA/TIA)
      a. 607 - Commercial Building Grounding and Bonding Requirements for Telecommunications
   2. Institute of Electrical and Electronics Engineers (IEEE) Publications:
      a. 81 - Guide for Measuring Earth Receptivity, Ground Impedance and Earth Surface Potential of a Ground System
      b. 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems
      c. 1100 - Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
   3. National Fire Protection Association (NFPA) Publication:
      a. 70 - National Electrical Code (NEC)
   4. Underwriters Laboratories, Inc. (UL) Publications:
      a. 83 - Thermoplastic-Insulated Wires and Cables
      b. 44 - Rubber-Insulated Wires and Cables
      c. 467 - Grounding and Bonding Equipment

1.03 SUBMITTALS

A. Product Data. Provide data for grounding electrodes and connectors.

B. Test Reports: Indicate overall resistance to ground.

C. Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors, as applicable.

D. Certifications: Two weeks prior to final inspection, deliver to the Owner's designated representative four copies of the certification that the material and installation is in accordance with the drawings and specifications and has been properly installed.

PART 2 - PRODUCTS

2.01 GROUNDING WIRES

A. General Purpose: UL and NEC approved types, copper, with TW, THW, XHHW or dual rated THHN-THWN insulation color identified green.

B. Isolated Power System: Type XHHW insulation with a dielectric constant of 3.5 or less.

C. Size wire not less than what is shown and not less than required by the NEC.

D. Stranded bare copper ground conductor where indicated on drawings.

2.02 GROUND RODS

A. Copper clad steel, 3/4-inch diameter by l0 feet long.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ground as shown and as hereinafter specified in accordance with the NEC.

B. System Grounding:
1. Ground the electrical service system neutral at service entrance equipment to grounding electrodes. Concrete encased electrodes shall be connected as the most effective grounding electrodes. Provide a completely grounded system in accordance with Article 250 of the NEC.
2. Ground each separately-derived system neutral to separate grounding electrode system. Transformer, UPS systems, power conditioners, inverters, or other power supplies are separately derived systems. Standby or emergency generators are separately derived systems if the neutral is bonded to the generator frame and if there is no direct connection of the generator neutral conductor to the service neutral conductor.

3. Provide communications system grounding conductor connected to separate electrode (ground bus) that is shall be installed in each IT room. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, cable trays, auxiliary gutters, meter fittings, boxes, cable armor, cable sheath, ground bus in electrical rooms and IT rooms, metal frame of the building or structure, ground ring, lightning down lead conductor, grounding conductor in raceways and cables, receptacle ground connectors, and metal underground water pipe. Bonding jumpers shall be installed around non-metal fittings or insulating joints to ensure electrical continuity. Bonding shall be provided where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.
4. Secondary service neutrals ground at the supply side of the secondary disconnecting means and at the related transformers.
5. Separately derived systems (transformers downstream from the service entrance) ground the secondary neutral.
6. Isolation transformers and isolated power systems shall not be system grounded.

C. Equipment Grounding:
1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

3.02 PRIMARY EQUIPMENT AND CIRCUITS

A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to a grounding electrode system, metal underground water pipe and driven ground rods for the grounding electrode. Where a new foundation/footer is constructed for a building/structure the grounding electrode system shall also be bonded to the concrete-encased electrode (reinforcing steel in foundation/footer). Coordinate with General Contractor.

B. Duct Banks and Manholes:
1. Provide a bare equipment grounding conductor in each duct bank containing medium or high voltage cables. Connect the grounding conductors to the switchgear ground bus, to all manhole hardware, to the cable shielding of medium or high voltage cable splices and terminations, and equipment enclosures.
2. Provide a grounding conductor having at least 50 percent ampacity of the largest phase conductor in the duct bank.
3. Connect the equipment grounding conductor to the ground rod.

C. Outdoor Fences: Connect outdoor fences around electrical equipment to the grounding electrode system.

D. Metallic Conduit: Metallic conduits which terminate without mechanical connection to a housing of electrical equipment by means of locknut and bushings or adapters, provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.

E. Lightning Arresters: Connect lightning arrester grounds to the equipment ground bus, or ground rods as applicable.

3.03 SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Connect the secondary service neutral to the ground bus in the service equipment.

B. Water Pipe and Supplemental Electrode:
1. Provide a ground conductor connection between the service equipment ground bus and the metallic water pipe system. Jumper insulating joints/meter in the water pipe.
2. Provide a supplemental ground electrode and bond to the water pipe ground, or connect to the service equipment ground bus.
3. Where a new foundation/footer is constructed for a building/structure, the grounding electrode system shall also be bonded to the concrete-encased electrode (reinforcing steel in foundation/ footer). Coordinate with General Contractor.

C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.

D. Switchgear and Switchboards:
1. Connect the various feeder green grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
2. Connect the grounding electrode conductor to the ground bus.
3. Connect the neutral to the ground bus (main bonding jumper).
4. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and ground wire to the ground bus.

E. Conduit Systems:
1. Ground all metallic conduit systems.
2. Non-metallic conduit systems shall contain a grounding conductor.
3. Conduit provided for mechanical protection containing only a grounding conductor, bond to that conductor at the entrance and exit from the conduit.

F. Feeders and Branch Circuits: Install green grounding conductors with feeders and branch circuits as follows:
   1. Feeders.
   2. Branch Circuits.
   3. Receptacle Outlets.
   4. Directly Connected Equipment, Appliances and Devices.
   5. Motors and Motor Controllers.
   6. Fixed Equipment and Appurtenances.
   7. Items of equipment where the final connection is made with flexible metal conduit shall have a grounding wire.
   8. Additional locations and systems as shown.

G. Boxes, Cabinets, Enclosures and Panelboards:
   1. Bond the grounding wires to each pull box, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass.
   2. Provide lugs in each box and enclosure for ground wire termination.
   3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.

H. Motors and Starters:
   1. Provide lugs in motor terminal box and starter housing for ground wire termination.
   2. Make ground wire connections to ground bus in motor control centers.

I. Receptacles are not approved for grounding through their mounting screws. Ground with a ground wire from green ground terminal on the receptacle to the outlet box ground screw.

J. Ground lighting fixtures to the green grounding conductor of the wiring system. During renovation, provide the green ground if it is not part of the system, or ground the fixtures through the conduit systems per means acceptable under the NEC. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

K. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.

3.04 CONDUCTIVE PIPING

A. Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.05 GROUND RESISTANCE

A. Grounding system ground resistance must comply with NEC. Provide additional ground rods as required until resistance reading is compliant with NEC.

B. Services at power company interface points shall comply with the power company ground resistance requirements.

C. Make necessary modifications to the ground electrodes for compliance that is needed without additional cost to the Owner, including the provisions of a multi-rod system.

3.06 GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth for not less than ten feet in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, install grounding electrodes in horizontal trenches to achieve the specified resistance.

D. In manhole, install ground rods with 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.

END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Conduit as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American National Standards Institute (ANSI) Publications:
      a. C80.1 - Rigid Steel Conduit, Zinc Coated
      b. C80.3 - Electrical Metallic Tubing, Zinc Coated
      c. C80.5 - Rigid Aluminum Conduit
   2. National Electrical Manufacturers Association (NEMA) Publications:
      a. FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
      b. RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
      c. TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
      d. TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
   3. National Electrical Contractors Association (NECA) Publication:
      a. Standard of Installation

1.03 SECTION INCLUDES

A. Rigid steel conduit.

B. PVC coated rigid steel conduit.

C. Flexible metal conduit.

D. Liquid-tight flexible metal conduit.

E. Electrical metallic tubing.

F. Nonmetallic conduit.

G. Flexible nonmetallic conduit.

H. Electrical nonmetallic tubing.

I. Fittings and conduit bodies.

1.04 RELATED SECTIONS

A. Section 26 05 01, “Electrical General Requirements”, applies to this Section with additions and modifications specified herein.

1.05 SUBMITTALS

A. Conduit and fittings (each type).

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

B. Protect PVC conduit from sunlight.

1.07 PROJECT CONDITIONS

A. Verify that field measurements are as shown on the Contract Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing when shown on the Contract Drawings are in approximate locations unless dimensioned. Route as required to complete wiring system.

1.08 QUALITY ASSURANCE

A. In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word “shall” has been substituted for “should” wherever it appears.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing when shown on the Contract Drawings are in approximate locations unless dimensioned. Route as required to complete wiring system.

1.09 QUALITY ASSURANCE

A. In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word “shall” has been substituted for “should” wherever it appears.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for these items, and requirements of NFPA 70.

B. Provide conduit types in specific installations as scheduled on Contract Drawings. Specific conduit material and installation specifications for the scheduled conduit type are specified herein.

2.02 CONDUIT AND FITTINGS

A. Rigid Steel Conduit (Zinc-coated): ANSI C80.1, UL 6.

B. Rigid Aluminum Conduit: ANSI C80.5, UL 6.

C. Rigid Nonmetallic Conduit: UL 651, UL 1684
   1. PVC Type EPC-40 and EPC-80, in accordance with NEMA TC2.
   2. Fiberglass conduit in accordance with NEMA TC14.

D. Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only.

E. Electrical Metallic Tubing (EMT): UL 797, ANSI C80.3.

F. Electrical Nonmetallic Tubing (ENT): NEMA TC13.

G. Plastic-coated Rigid Steel and IMC Conduit: NEMA RN1, Type 40 (40 mils thick).

H. Flexible Metal Conduit: UL 1.
   1. Liquid-tight Flexible Metal Conduit, Steel: UL 360.

I. Fittings for Metal Conduit, EMT, and Flexible Metal Conduit: UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B. Fittings shall match conduit type and material.
   1. Fittings for Rigid Metal Conduit and IMC: Threaded-type. Split couplings unacceptable.
   2. Fittings for EMT: Compression type.
   3. Fittings for Use in Hazardous Locations: UL 886.

J. Fittings for Rigid Nonmetallic Conduit: NEMA TC3. Fittings shall match conduit type and material.

2.03 FIBER OPTIC SYSTEMS

A. For conduit systems that are intended for the installation of fiber optic cables, all conduit bends radii shall meet or exceed minimum radius in accordance with installed fiber optic bending limitation specifications.

B. Where conduit bodies are used in 90 degree sections of conduit runs, only “Optical LB”, or equivalent shall be used.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

B. Underground Service: Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

C. Hazardous Locations: Work in hazardous locations, as defined by NFPA 70, shall be performed in strict accordance with NFPA 70 for particular "Class", "Division", and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70. Conduit shall have tapered threads.

D. Service Entrance Identification: Service entrance disconnect devices, switches, or enclosures shall be labeled or identified as such.

1. Labels: Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure shall be provided only as permitted by NFPA 70.

E. Wiring Methods: Provide insulated conductors installed in conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Provide insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green conductor for grounding conductors installed in conduit or raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power

circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire walls, fire partitions, or floors shall be metallic on both sides of fire walls, fire partitions, or floors for minimum distance of 6 inches.

1. Aluminum Conduit: Do not install underground or encase in concrete. Do not use brass or bronze fittings.
2. Restrictions Applicable to EMT:
    a. Do not install underground.
    b. Do not encase in concrete.
    c. Do not use in areas subject to severe physical damage.
    d. Do not use in hazardous areas.
    e. Do not use outdoors.
3. Nonmetallic Conduit: Conduit shall not penetrate fire walls, fire partitions, or floors.
4. ENT: ENT may be provided in walls, floors, and ceilings only when protected by thermal barriers identified as having minimum 15-minute finish rating. If ENT is used, provide required thermal barriers, whether indicated or not.
    a. Following restrictions apply to ENT:
    b. Do not route exposed.
    c. Do not route above suspended ceilings (i.e., between suspended ceilings and permanent ceilings).
    d. Do not use in feeder circuits.
    e. Do not install underground.
    f. Do not encase in concrete.
    g. Do not use in areas subject to severe physical damage including, but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.
    h. Do not use in hazardous areas.
    i. Do not use outdoors.
    j. Do not use in sizes larger than 2 inches.
    k. Do not use in penetrating fire rated walls, partitions, etc.
5. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80.
    a. Do not use in feeder circuits unless otherwise indicated.
    b. Do not use in areas subject to severe physical damage including, but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.
    c. Do not use in hazardous areas.
    d. Do not use in penetrating fire-rated walls or partitions, fire rated floors, etc.

6. Service Entrance Conduit, Overhead: Rigid steel or IMC from service entrance to service entrance fitting or weatherhead outside building.
7. Service Entrance Conduit, Underground: Galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.
8. Underground Conduit Other Than Service Entrance: Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab; plastic coating shall extend minimum 6 inches above floor.
9. Conduit in Floor Slabs: Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40.
10. Conduit Interior to Buildings for 400 Hz Circuits: Aluminum or nonmetallic. Where 400-Hz circuit runs underground or through concrete, conduit shall be PVC Schedule 80.
11. Conduit for Circuits Rated Greater Than 600 Volts: Rigid metal conduit or IMC only.

F. Conduit Installation: Unless indicated otherwise, conceal conduit within finished walls (existing or proposed), above ceilings, below floors or within floor slabs. With written approval by the Owner's Designated Representative where conduit cannot physically be installed concealed, install decorative surface metal raceway as manufactured by Wiremold Series 2400, or approved equal.
1. For new conduit runs in existing locations, Contractor to field verify all proposed locations prior to installation. Installation of conduit shall be located and installed:
    a. So as to not interfere with existing utilization equipment.
    b. Not in front of intake/exhaust fans and louvers.
    c. Not in front of access panels.
    d. Not in front of doors or windows.
    e. In a location that does not allow maintenance and clearance to existing and proposed mechanical and electrical equipment
    f. Not on floor or at a height above floor so as to be a tripping hazard,
    g. Not installed in dedicated space that would limit an overhead cranes or similar lifting device's ability to remove intended equipment below. This includes but is not limited to access hatches, crane trucks, crane hoists, movement along crane rails, jib crane full swinging arc/areas, etc.
2. Contractor to notify Owner and Owners Designated Representative of all potential conduit installation conflicts with existing equipment, HVAC, plumbing, building or structural systems prior to field construction of conduit systems.

G. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and

structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits in crawl space under slab as if exposed.

1. Conduit Through Floor Slabs: Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.
2. Conduit Support: Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration- resistant and shock-resistant. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended- ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multi-story buildings by U-clamp hangers at each floor level and at 10-foot maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. Support raceways within three (3) feet of each outlet box, junction box, cabinet or enclosure.
3. Directional Changes in Conduit Runs: Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.
4. Pull Wire: Install pull wires in empty conduits in which wire is to be installed by others. Pull wire shall be plastic having minimum 200-pound tensile strength. Leave minimum 12 inches of slack at each end of pull wire.

5. Telephone and Signal System Conduits: Install in accordance with specified requirements for conduit and with additional requirement that no length of run shall exceed 150 feet for trade sizes 2 inches and smaller and shall not contain more than two 90-degree bends or equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits 1-inch trade size and larger shall be minimum five times nominal diameter. Terminate conduit in terminal cabinet with two locknuts and plastic bushing.
6. Locknuts and Bushings: Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.
7. Stub-ups: Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.
8. Flexible Connections: Provide flexible connections of short length, 6-foot maximum, for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Provide liquid-tight flexible conduit in wet locations. Provide separate ground conductor across flexible connections.
9. Arrange conduit to maintain headroom and present neat appearance.
10. Cut conduit square using saw or pipe cutter; deburr cut ends. For field cut threaded conduits, provide field applied anti-corrosion material to the threads in accordance with the manufacturer's instructions and per the NEC. Product shall be Thomas & Betts KOPR-Shield or approved equal.
11. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
12. Install no more than equivalent of three 90 degree bends between boxes.
13. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
14. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
15. Use Suitable caps to protect installed conduit against entrance of dirt and moisture.
16. Ground and bond conduit under as per NEC 250.

3.02 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in other sections.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation. Coordinate installation with representative of roofing material manufacturer to maintain any roof warranty.

END OF SECTION

SECTION 26 05 35

OUTLET, JUNCTION AND PULL BOXES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Outlet, Junction and Pull Boxes, as shown on the Plans, as specified, and/or directed.

B. Plans (drawings) are diagrammatic and show only approximate locations of equipment, fixtures, devices, conduit routing, etc. Plans may not show exact quantity and locations of Junction and Pull Boxes required for a complete installation. Exact locations and routing shall be determined in the field and shall suit the job conditions. Quantities and locations of Outlet, Junction, and Pull Boxes shall be provided to suit the installed arrangement and meet all NEC and local code requirements.

1.02 REFERENCES

A. NEMA

B. UL. (Specifically UL 514A)

C. NFPA 70

1.03 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.
   1. For fire rated construction, prove that materials and installation methods proposed for use are in accordance with the listing requirements of the classified construction.

B. Shop Drawings: Plans, elevations, sections, and details for all custom enclosures and cabinets

1.04 GENERAL REQUIREMENTS

A. Section 26 05 01, "Electrical General Requirements", applies to this Section, with the additions and modifications specified herein.

PART 2 - PRODUCTS

2.01 GALVANIZED STEEL OUTLET BOXES

A. Standard galvanized steel boxes and device covers by Appleton Electric Co., Cooper/Crouse-Hinds, Hubbell, or approved equal.

2.02 GALVANIZED STEEL JUNCTION AND PULL BOXES

A. Code gage, galvanized steel screw cover boxes by Hoffman Enclosures Inc., Hubbell Wiegmann, or approved equal

2.03 THREADED TYPE BOXES

A. Outlet Boxes: For Dry, Damp Locations: Zinc electroplate malleable iron or cast iron alloy boxes by Appleton Electric Co., Cooper/Crouse-Hinds Co., or approved equal with zinc electroplate steel covers to suit application. For classified spaces, provide outlet boxes rated for Class I, Div. 1, group D hazardous areas as manufactured by Crouse-Hinds, Appleton or approved equal.

B. For Wet Locations: Malleable iron or cast iron alloy boxes with hot dipped galvanized or other specified corrosion resistant finish as produced by Cooper/Crouse-Hinds (hot dipped galvanized or Corro-free epoxy powder coat), or OZ/Gedney Co. (hot dipped galvanized), with stainless steel cover screws, and malleable iron covers gasketed to suit application.

C. Junction and Pull Boxes:
   1. For Dry, Damp Locations: Zinc electroplate cast iron boxes by Appleton Electric Co., Cooper/Crouse-Hinds, or approved equal with zinc electroplate steel or cast iron cover.
   2. For Wet Locations: Cast iron boxes by Cooper/Crouse-Hinds' (hot dipped galvanized or Corro-free epoxy powder coat), or OZ/Gedney Co. (hot dipped galvanized), or approved equal, with stainless steel cover screws and cast iron cover gasketed to suit application.
   3. For classified spaces, provide junction and pull boxes rated for Class I, Div. 1, group D hazardous areas as manufactured by Crouse-Hinds, Appleton or approved equal.

D. Conduit Bodies, Threaded (Provided with a Volume Marking):
   1. For Dry, Damp Location: Zinc electroplate malleable iron or cast iron alloy bodies with zinc electroplate steel covers; Appleton Electric Co.'s Unilets, Cooper/Crouse-Hinds' Condulets, or approved equal.
   2. For Wet Locations: Malleable iron or cast iron alloy bodies with hot dipped galvanized or other specified corrosion resistant finish; Cooper/Crouse-Hinds' Condulets (hot dipped galvanized or Corro-free epoxy power coat), or OZ/Gedney Co.'s Conduit Bodies (hot dipped galvanized) or approved equal, with stainless steel cover screws and malleable iron covers gasketed to suit application.

3. For classified spaces, provide outlet conduit bodies rated for Class I, Div. 1, group D hazardous areas as manufactured by Crouse-Hinds, Appleton, or approved equal.

2.04 SPECIFIC PURPOSE OUTLET BOXES

A. As fabricated by manufacturers for mounting their equipment.

PART 3 - EXECUTION

3.01 PREPARATION

A. Before proceeding with the installation of junction and pull boxes, check the locations with the Director's Representative and have same approved.

3.02 INSTALLATION

A. Mounting Position of Wall Outlets For Wiring Devices: Unless otherwise indicated, install boxes so that the long axis of each wiring device will be vertical.

B. Height of Wall Outlets: Unless otherwise indicated, locate outlet boxes with their center lines at the following elevations above finished floor:

Switches	4'-0"
Single & Duplex Receptacles	1'-6"
Special Purpose Receptacles	4'-0"
Telephone/Data Outlets	1'-6"
Telephone Outlets (Wall Phones)	4'-0"
Above-Counter Devices	8" Above Counter
Fire Alarm Manual Station	4'-0"
Fire Alarm Notification Device	7'-0"

C. Wall Outlet Location: Locations shown on drawings are approximate only. Locate wall outlet boxes as near to position indicated as possible, but so as to avoid conflicts with other trades (architectural, mechanical, plumbing, structural, etc.).

D. Where devices of different mounting heights are shown on drawings at same location, align outlet boxes along a common vertical line.

E. Outlet boxes in a common wall serving separate rooms shall not be installed back-to-back.

F. Outlet boxes shall be sized to accommodate the device that is to be installed.

G. Provide box extensions and/or trim rings as required to accommodate construction of wall/ceiling in which boxes are recessed.

H. Supplementary Junction and Pull Boxes: In addition to junction and pull boxes indicated on the drawings and required by NFPA 70, provide supplementary junction and pull boxes as follows:
   1. When required to facilitate installation of wiring.
   2. At every third 90 degree turn in conjunction with raceway sizes over 1 inch.
   3. At intervals not exceeding 100 feet in conjunction with raceway sizes over 1 inch.

I. All Junction and Pull Boxes shall have a screw-on cover plate. Cover plate shall match box material and construction.

J. Junction and Pull Boxes shall be installed in locations that are readily accessible, and shall not be blocked by equipment, piping, ducts, structural supports, etc.

3.03 OUTLET, JUNCTION, AND PULL BOX SCHEDULE

A. Boxes For Concealed Conduit System:
   1. Non-Fire Rated Construction:
      a. Depth: To suit job conditions and comply with NFPA 70 Article 370.
      b. For Lighting Fixtures: Use galvanized steel outlet boxes designed for the purpose.
         1) For Fixtures Weighing 50 lbs. or Less: Box marked "FOR FIXTURE SUPPORT".
         2) For Fixtures More Than 50 lbs: Box listed and marked with the weight of the fixture to be supported (or support fixture independent of the box).
      c. For Ceiling Suspended Fans:
         1) For Fans Weighing 35 lbs or Less: Marked "Acceptable for Fan Support."
         2) For Fans Weighing More Than 35 lbs, up to 70 lbs: Marked "Acceptable for Fan Support up to 70 lbs (or support fan independent of the box)."
      d. For Junction and Pull Boxes: Use galvanized steel boxes with flush covers.
      e. For Switches, Receptacles, Etc:
         1) Plaster or Cast-In-Place Concrete Walls: Use 4 inch or 4-11/16 inch galvanized steel boxes with device covers.
         2) Walls Other Than Plaster or Cast-In-Place Concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.

B. Boxes For Exposed Conduit System:

1. Dry and Damp Locations: Use zinc electroplate or hot dipped galvanized threaded type malleable iron or cast iron alloy outlet, junction, and pull boxes or conduit bodies provided with a volume marking in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.
    a. Galvanized steel boxes may be used in conjunction with conduit sizes over 1 inch in non-hazardous dry and damp locations.
    b. Galvanized steel boxes may be used in conjunction with electrical metallic tubing where it is allowed (specified) to be installed exposed as branch circuit conduits at elevations over 10’-0” above finished floor.
2. Wet Locations: Use threaded type malleable iron or cast iron alloy outlet junction, and pull boxes or conduit bodies (provided with a volume marking) with hot dipped galvanized or other specified corrosion resistant coating in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.
    a. Use corrosion resistant boxes in conjunction with plastic coated rigid ferrous metal conduit.

C. Specific Purpose Outlet Boxes: Use to mount equipment when available and suitable for job conditions. Unless otherwise specified, use threaded type boxes with finish as specified for exposed conduit system, steel (painted) for surface metal raceway system and galvanized steel for recessed installations.

3.04 LABELING

A. Identify junction and pull boxes for system served (i.e. power, lighting, fire alarm, telephone, data, public address, nurse call, etc.), using stencil lettering on box cover.

B. Identify panelboard and circuit number of all conductors contained within junction and pull boxes, using stencil lettering on box cover.

C. Identify junction and pull boxes for systems over 600V as follows: “DANGER HIGH VOLTAGE – KEEP OUT.” Label shall be white stencil lettering, minimum 1” text height, on box cover.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Wiring Devices as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. NEMA

B. UL

C. NFPA 70

1.03 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

1.04 RELATED SECTIONS

A. Section 26 05 01, “Electrical General Requirements”, applies to this Section, with the additions and modifications specified herein.

PART 2 - PRODUCTS

2.01 SWITCHES

A. Local Switches, Single Pole: 20A, 120/277 V ac; Bryant’s 4901, Crouse-Hinds/AH’s 1991, Hubbell’s 1121/1221, Leviton’s 1121/1221, Pass & Seymour’s 20AC1.

B. Local Switches, Double Pole: 20A, 120/277 V ac; Bryant’s 4902, Crouse-Hinds/AH’s 1992, Hubbell’s 1222/1122, Leviton’s 1222/1122, Pass & Seymour’s 20AC2.

C. Local Switches, Three-Way: 20A, 120/277 V ac; Bryant’s 4903, Crouse-Hinds/AH’s 1993, Hubbell’s 1223/1123, Leviton’s 1223-2/1123-2, Pass & Seymour’s 20AC3.

D. Local Switches, Four-Way: 20A, 120/277 V ac; Bryant’s 4904, Crouse-Hinds/AH’s 1994, Hubbell’s 1224/1124, Leviton’s 1224-2/1124-2, Pass & Seymour’s 20AC4.

E. Local Switches, Dimming: 20A, 120/277 V ac; Eaton's WBSD-010SLD, Leviton's 66EV-10W, Pass & Seymour's WS4FBL3PW.

2.02 RECEPTACLES

A. Federal Spec./NEMA Grade Receptacles:
   1. Single receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5361, Crouse-Hinds/AH's 5361, Hubbell's 5361, Leviton's 5361, or Pass & Seymour's 5361.
   2. Duplex receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5362, Crouse-Hinds/AH's 5739-S, Hubbell's 5362, Leviton's 5362, Pass & Seymour's 5362, or Daniel Woodhead's 5362 DW.

B. Ground Fault Interrupter Receptacles: Duplex receptacle rated 20A (NEMA 5-20R), circuit ampacity 20A; Bryant's GFR53FT, Crouse-Hind/AH's GF5342, Hubbell's GF 5352, Leviton's 6899, Pass & Seymour's 2091S,

2.03 WALL PLATES

A. Stainless Steel Wall Plates: Type 302 stainless steel with satin finish. All areas except finished spaces or wet locations.

B. Weatherproof/Wet Location Covers: UL 514D type "extra duty". Thomas & Betts Red Dot Code Keeper type 2CKU or equal.

C. Finished areas: Polycarbonate. Color to match device color.

2.04 NAMEPLATES

A. Phenolic Type: Standard phenolic nameplates with 3/16 inch minimum size lettering engraved thereon.

B. Embossed Aluminum: Standard stamped or embossed aluminum tags, 3/16 inch minimum size lettering, as produced by Seton Name Plate Corp. or Tech Products Inc.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install wiring devices in outlet boxes.

B. Local Switches:
   1. Install local switches rated 20A, 120/277 V ac for switches unless otherwise shown on the drawings or specified.
   2. Where more than one switch occurs at same location in a 120 volt system, arrange switches in gangs and cover with one face plate.

3. Install single and double pole switches so that switch handle is up when switch is in the “On” position.

C. Receptacles:
   1. Install Specification Grade receptacles, NEMA 5-20R, 20A, 125 V, 2P, 3W, for duplex receptacles and single receptacles unless otherwise shown on the drawings or specified.
   2. Install receptacles with ground pole in the up position.

D. Wall Plates:
   1. Install wall plates on all wiring devices in dry locations, with finish to match hardware in each area.

E. Weatherproof In-use Covers: Install weatherproof covers on wiring devices in damp and wet locations.

F. Nameplates: Provide phenolic or embossed aluminum nameplate for each special purpose receptacle indicating phase, ampere and voltage rating of the circuit. Attach nameplate with rivets or tamperproof fasteners to wall plate or to wall above receptacle. Wall plates may be engraved with required data in lieu of separate nameplates.

G. Labels: Provide electronically-generated, self-sticking label at each wiring device. Label shall indicate panel designation and circuit number associated with respective device. Label shall be attached to outside of wall plate.

H. Where Contract Drawings call out a classified area all equipment/devices and wiring methods to be suitable for this area per NEC. Refer to Contract Drawings for classified area locations.

END OF SECTION

SECTION 26 28 14

CIRCUIT BREAKERS FOR EXISTING PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Circuit Breakers For Existing Panelboards, as shown on the Plans, as specified and/or directed.

1.02 SUBMITTALS

A. Not Required.

PART 2 - PRODUCTS

2.01 CIRCUIT BREAKERS

A. Similar to existing circuit breakers.

B. Compatible with existing panelboard.

C. Number of poles and ampere trip rating as indicated on Contract Drawings.

D. Complete with accessories required for installation.

E. All heating and air conditioning circuit breakers shall be “HACR” rated.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install new circuit breakers in existing panelboards where indicated.

B. Add new circuits equally across phases to prevent overloading any phase in the panelboard. After new and existing circuits are energized, take current reading on panelboard feeder during a heavy usage time period. If phases are substantially unbalanced, rearrange both new and existing circuits in panelboard to equally distribute load between all phases, and provide new typewritten directory indicating equipment controlled by each circuit breaker.

END OF SECTION

SECTION 26 28 16

SAFETY SWITCHES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Safety Switches as shown on the Plans, as specified, and/or directed.

1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

PART 2 - PRODUCTS

2.01 SAFETY SWITCHES (SINGLE THROW)

A. NEMA KS1, switches serving as motor-disconnect means shall be horsepower rated. Provide heavy-duty type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches.

B. Fused Switches: Provide fused switch as required or indicated. Fused switches shall utilize Class R fuse holders and fuses unless otherwise indicated.

C. Enclosure: Enclosure shall be NEMA rated for installation environment.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install switches so that the maximum height above the floor to the center of the operating handle does not exceed 6'-6".

B. Identify each safety switch, indicating purpose or load served:
   1. NEMA 1 Enclosures: Rivet or bolt nameplate to the cover.
   2. NEMA 12 Enclosures: Rivet or bolt and gasket nameplate to the cover.
   3. NEMA 3R, 4, 4X Enclosures: Attach nameplate to the cover using adhesive specifically designed for the purpose, or mount nameplate on wall or other conspicuous location adjacent to switch. Do not penetrate enclosure with fasteners.

END OF SECTION

SECTION 26 51 01

INTERIOR LIGHTING

PART 1 - GENERAL

1.01 SCOPE

A. The work under this Interior Lighting includes interior luminaires and accessories, exit signs, and building-mounted exterior lighting.

1.02 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.03 REFERENCE STANDARDS

A. RoHS – Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

B. LM-79-08 (or latest) – IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.

C. LM-80-08 (or latest) – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

D. TM-21-11 (or latest) – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

E. NEMA SSL 1-2010 (or latest) – Electronic Drivers for LED Devices, Arrays, or Systems.

1.04 SUBMITTALS

A. Include outline drawings, lamp and ballast data, support points, weights, accessory information and performance data for each luminaire type.

B. For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:
   1. Luminaire:
      a. Manufacturer and catalog number,
      b. Type (identification) as indicated on the plans and schedule,
      c. Delivered lumens,
      d. Input watts,
      e. Efficacy,
      f. Color rendering index.

2. Driver:
   a. Manufacturer and catalog number,
   b. Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
   c. Power Factor, Crest Factor, THD, etc.

1.05 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under Section General Requirements.

1.06 EXTRA MATERIALS

A. Provide three (3) percent of each lamp type, but not less than one (1) of each type.

B. Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LED's are integrated into the luminaire and are not separate components, provide one (1) of each of these types of luminaires.

C. Provide one (1) LED driver or ballast of each type.

1.07 DEFINITIONS

A. Driver: The power supply used to power LED luminaires, modules, or arrays.

B. L70, $L_{70,}$ or $L_{70\%}$: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LED's original light output. This test is being developed by the IES and is currently described by TM-21-11.

C. LEDs: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays, complete with driver.

D. LED luminaire failure: Negligible light output from more than 10 percent of the LED's constitutes luminaire failure.

PART 2 - PRODUCTS

2.01 INTERIOR LUMINAIRES AND ACCESSORIES

A. See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Luminaires manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated luminaires, and meet the intent of the design.

B. Luminaire shall be listed by a NRTL (Nationally Recognized Testing Laboratory: e.g., UL, ETL, etc.).

C. Provide luminaires with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

D. Fluorescent T8 lamps and ballasts shall be listed on CEE high-performance qualifying product list and approved by Focus–On–Energy.

2.02 GENERAL USE LAMPS

A. General Use Incandescent Lamps and Incandescent Reflector Lamps are prohibited. Use LED retrofit lamps or LED luminaires in lieu of incandescent or halogen luminaires. LED retrofit lamps shall be:
   1. Rated for the voltage of the incandescent lamp/luminaire they are replacing.
   2. Dimmable where required as indicated on the Plans.
   3. Rated for the luminaire in which they are being installed. Verify whether the luminaire is enclosed and whether the LED retrofit lamp is rated for enclosed luminaires and the temperatures that will be encountered.
   4. LED lamps/luminaires shall provide delivered footcandles equal to or greater than the footcandles provided by an equivalent incandescent lamp/luminaire.
   5. LED retrofit lamps shall have an average rated life of 25,000 hours, minimum.
   6. Lamp color temperature shall be nearly equal to the incandescent lamp it is replacing.

B. All lamps shall be new.

2.03 LED LUMINAIRES

A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
   1. Minimum Light Output.
   2. Zonal Lumen Requirements.
   3. Minimum Luminaire Efficacy.
   4. Minimum CRI.
   5. L70 Lumen Maintenance.
   6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

B. Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the Plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).

C. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.

D. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.

E. Luminaire shall be mercury-free, lead-free, and RoHS compliant.

F. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

G. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.

H. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.

I. Lumen output shall not depreciate more than 20% after 10,000 hours of use.

J. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.

K. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.

L. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -40°F to 104°F (-40°C to 40°C).

M. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.

N. Luminaire shall have a maximum Total Harmonic Distortion (THD) of $\leq$20% at full input power and across specified voltage range.

O. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

P. All luminaires shall be provided with knockouts for conduit connections.

Q. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).

R. Provide all of the following data on submittals:
   1. Delivered lumens
   2. Input watts
   3. Efficacy
   4. Color rendering index.

S. LED Luminaires used for Emergency Egress Lighting: The failure of one LED shall not affect the operation of the remaining LEDs.

T. Emergency LED Luminaire Compatibility with Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

2.04 LED DRIVERS

A. General Drivers:
   1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
   2. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
   3. Driver shall have a rated life of 50,000 hours, minimum.
   4. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
   5. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
   6. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
   7. Driver shall have a maximum Total Harmonic Distortion (THD) of $\leq$20% at full input power and across specified voltage range.
   8. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
   9. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
   10. Provide all of the following data on submittals:
   11. Input watts
      a. Power Factor (pf)
      b. Crest Factor (cf) at full input power
      c. Total Harmonic Distortion (THD).

B. Dimming Drivers:
   1. LED driver shall be compatible with dimming controls where dimming is indicated on the Plans. Dimmable drivers shall use Dimming Constant Current (DCC), Constant Voltage, or Pulse Width Modulation (PWM) operation.

2. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.
3. Continuous Dimming Drivers: LED luminaires shall dim to (10%, 1%, or 0.1%) as specified in the Luminaire Schedule on the Plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verify ceiling types with Architectural plans or with existing ceilings. Verify specified luminaires are compatible with specified ceiling type(s) prior to ordering luminaires.

B. Install in accordance with manufacturer's instructions.

C. Install suspended luminaires using aircraft cable, or pendants supported from swivel hangers. Heavy-duty chain supports may be used where indicated on the luminaire schedule. Provide aircraft cable, pendants, or chain lengths required to suspend luminaire at indicated height. All aircraft cables or pendant supported luminaires shall have an independent support to structure at all cable or pendant support locations. When chain is used, tie-wrap the luminaire wiring method to the chain.

D. Support luminaires larger than 2 x 4 foot (600 x 1200 mm) size independent of ceiling framing.

E. Provide independent support for all luminaires over 50 lbs.

F. Locate ceiling luminaires as indicated on reflected ceiling plan.

G. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

H. The Contractor shall install luminaire supports as required. Luminaire installations with luminaires supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all luminaires adequately, providing extra steel work for the support of luminaires if required. Any components necessary for mounting luminaires shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.

I. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.

J. Install recessed luminaires to permit removal from below.

K. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

L. Install code required hardware to secure recessed grid-supported luminaires in place.

M. Install wall mounted luminaires and exit signs at height as scheduled. Use pendants supported from swivel hangers in exposed ceiling/structure locations where necessary to mount exit signs at the specified height.

N. Install accessories furnished with each luminaire.

O. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

P. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

Q. Install specified lamps in each luminaire and exit sign.

R. HID High-Bay or Low-Bay Luminaires: Use power hook hangers rated 500 pounds (225 kg) minimum and provide safety chain between ballast and structure. Also provide safety chain between reflector and ballast.

S. Dimmed luminaire circuits shall have separate neutrals.

T. Dimmed LED luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires don't "glow" at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to DFD.

U. All lamps shall be delivered to the job in sealed cartons and protected from dirt and dust during storage on the project. Lamps shall be taken directly from the cartons and installed in the luminaire with special care so that they do not become dusty and are not soiled in the operation.

V. Lamps installed in luminaires using dimming ballasts shall be burned in at 100% rated output by the contractor for a minimum of 100 hours as recommended by the ballast manufacturer.

W. All new lamps shall be operational at the Substantial Completion of the project.

3.02 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Aim and adjust luminaires as indicated on drawings or as directed by the A/E.

C. Touch up luminaire finish at completion of work.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Interface with air handling accessories furnished and installed under Division 23.

B. Provide controls as indicated on the plans. Refer to Section 26 27 26, “Wiring Devices”. Controls shall be compatible with the luminaires/ballasts/drivers being installed.

3.04 ZERO-TO-10V DIMMING CONTROL WIRING INSTALLATION

A. Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept separate from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of Different Systems does not apply to Class 2 conductors per NEC 300.3(C)(1), Informational Note No.1.

B. Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or conduit stub for the 0-10V control wiring.

C. At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used for the line-voltage power and the 0-10V wiring. The EC shall use a cable connector at the opening for the 0-10V wiring. Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum separation of 6 mm (0.25 in.) per NEC 725.136(D).

D. Exposed 0-10V cables shall be installed in separate conduits from line-voltage conductors.

E. The 0-10V cables may be routed in free air where concealed above accessible ceilings. Cables routed in free air shall observe the following installation requirements:

1. The 0-10V cables may be tie-wrapped to the outside of the luminaire power raceway where allowed by NEC 300.11(B)(2). Tie-wraps shall be UL listed for UV resistance. Care should be taken in the use of cable ties to secure and anchor the cabling. Ties shall not be over tightened as to compress the cable jacket. No sharp burrs shall remain where excess length of the cable tie has been cut.

2. Cabling shall be neatly run at right angles and be kept clear of other trades work.
3. Cabling shall be secured within twelve (12) inches of direction change or termination.
4. Cabling shall be supported at a maximum of 5-foot intervals utilizing "J-Hook" or "Bridle Ring" supports anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Cable supports shall be installed to maintain cable bend to larger than the minimum bend radius.
5. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach cable in any manner to the ceiling grid wires.
6. All cables shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.
7. Cable manufacturer's minimum bend radius shall be observed in all instances.
8. Use suitable cable fittings and connectors.

3.05 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.06 LUMINAIRE CONNECTIONS

A. Metal-Clad (MC) Cable Whips
1. Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for luminaire whips where 0-10V dimming control wiring is required. Whips may not exceed six (6) feet in length. Examples of such products are Encore Wire® MC-LED™ or Southwire® MC-PCS Duo™. Manufacturer's names and catalog numbers are used for quality and performance only. MC Cables manufactured by others shall be equally acceptable provided they meet or exceed in performance and quality as specified.

B. Recessed, including Master-Satellite connections:
1. Use a luminaire fixture whip from a J-box for recessed lay-in luminaires. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
2. Cable/Conduit whips shall be 3/8" (10 mm) minimum diameter, six feet (1.8 m) maximum length.

3. Flexible whips or pre-wired systems between master and satellite luminaires may be supported by the ceiling grid wires.
4. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or snap-in connector type, including those used on the master-satellite units.

C. Chain or Cable Hung (unfinished spaces):
1. Use manufacturer's SO cord or a luminaire fixture whip from a J-box. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
2. Conduit whips shall be 3/8" (10 mm) minimum diameter. Conduit whip or SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the chain/cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
3. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
4. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or snap-in connector type, including those used on the master-satellite units.
5. Conduit whip slack shall be tie-wrapped to the chain supports. Tie-wraps shall be UL listed for UV resistance.

D. Cable Hung (finished spaces):
1. Use manufacturer's SO cord from luminaire to a J-box.
2. SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
3. SO cord slack may be tie-wrapped to the cable supports. Tie-wraps shall be UL listed for UV resistance.
4. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.

E. Surface Mounted (unfinished spaces): Provide direct conduit and box connection.

F. Surface Mounted (finished spaces): Provide direct conduit and box connection. Use surface metal raceway where indicated on drawings. Conceal box and conduit where appropriate. Flexible metal conduit shall not be used where the conduit is exposed.

END OF SECTION

SECTION 26 56 00

SITE LIGHTING

PART 1 - GENERAL

1.01 SCOPE

A. The work under this section Site Lighting includes exterior luminaires and accessories, poles, and foundations.

1.02 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.

1.03 REFERENCE STANDARDS

A. International Building Code IBC 1807.3 Embedded Posts and Poles

B. RoHS – Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

C. LM-79-08 (or latest) – IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.

D. LM-80-08 (or latest) – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

E. TM-21-11 (or latest) – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

F. NEMA SSL 1-2010 (or latest) – Electronic Drivers for LED Devices, Arrays, or Systems.

1.04 DEFINITIONS

A. Driver: The power supply used to power LED luminaires, modules, or arrays.

B. L70, $L_{70,}$ or $L_{70\%}$: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LEDs original light output. This test is being developed by the IES and is currently described by TM-21-11.

C. LEDs: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars or arrays, complete with driver.

D. LED luminaire failure: Negligible light output from more than 10 percent of the LEDs constitutes luminaire failure.

1.05 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each luminaire, pole and base.

B. Product Data:
   1. For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers, and required accessories:
      a. Luminaire:
         1) Manufacturer and catalog number,
         2) Type (identification) as indicated on the plans and schedule,
         3) Delivered lumens,
         4) Input watts,
         5) Efficacy,
         6) Color rendering index,
         7) Performance data, and
         8) Effective Projected Area (EPA).
      b. Driver:
         1) Manufacturer and catalog number,
         2) Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
         3) Power Factor, Crest Factor, THD, etc.
      c. Pole (if applicable):
         1) Diameter
         2) Height
         3) Pole thickness
         4) Weight

C. Manufacturer's Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency specified under "Regulatory Requirements".
   2. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

D. Light Layout: Provide a computer-generated factory point-by-point foot-candle layout of the project for each area involved.

E. Post Installation Report: Provide to the Engineer the results of the measured foot-candle level for each area involved.

1.06 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of each luminaire, pole, and underground circuit.

B. Provide record drawings of the final, as installed and measured, point-by-point foot-candle layout for each area involved.

1.07 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under Section General Requirements.

1.08 COORDINATION

A. Use bolt templates and pole mounting accessories to install anchor bolts in pole base.

1.09 EXTRA MATERIALS

A. Provide three (3) percent of each lamp type, but not less than one (1) of each type.

B. Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LEDs are integrated into the luminaire and are not separate components, then provide one (1) of each of these types of luminaires.

C. Provide one (1) LED driver of each type.

D. Provide five (5) percent of total fuses provided for each size, but not less than one (1) of each size.

PART 2 - PRODUCTS

2.01 LUMINAIRES

A. See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Luminaires manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated luminaires, and meet the intent of the design.

B. Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).

C. Provide luminaires with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

2.02 LED LUMINAIRES

A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
   1. Minimum Light Output.
   2. Zonal Lumen Requirements.

3. Minimum Luminaire Efficacy.
4. Minimum CRI.
5. L70 Lumen Maintenance.
6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

B. Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the Plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).

C. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.

D. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.

E. Luminaire shall be mercury-free, lead-free, and RoHS compliant.

F. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

G. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.

H. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.

I. Lumen output shall not depreciate more than 20% after 10,000 hours of use.

J. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.

K. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.

L. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -40°F to 104°F (-40°C to 40°C).

M. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.

N. Luminaire shall have a maximum Total Harmonic Distortion (THD) of ≤20% at full input power and across specified voltage range.

O. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

P. All luminaires shall be provided with knockouts for conduit connections.

Q. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).

R. Provide all of the following data on submittals:
1. Delivered lumens
2. Input watts
3. Efficacy
4. Color rendering index.

S. LED Luminaires used for Emergency Egress Lighting: The failure of one LED shall not affect the operation of the remaining LEDs.

T. Emergency LED Luminaire Compatibility with Inverters: Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

2.03 LED DRIVERS

A. General:
1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
2. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
3. Driver shall have a rated life of 50,000 hours, minimum.
4. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
5. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
6. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
7. Driver shall have a maximum Total Harmonic Distortion (THD) of ≤20% at full input power and across specified voltage range.
8. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
9. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.

10. Provide all of the following data on submittals:
    a. Input watts
    b. Power Factor (pf)
    c. Crest Factor (cf) at full input power
    d. Total Harmonic Distortion (THD).

B. Dimming Drivers:
1. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC), Constant Voltage, or Pulse Width Modulation (PWM) operation.
2. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.
3. Continuous Dimming Drivers: LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

C. Drivers for Bi-Level Switching:
1. Drivers shall be compatible with bi-level switching control by motion sensors where indicated on the drawings.

2.04 MOTION SENSORS FOR BI-LEVEL SWITCHING

A. Provide luminaires with motion sensors for bi-level switching as indicated on the drawings. Luminaires shall normally operate at a low level during nighttime hours, but shall increase to 100% output when they sense motion. Motion sensor shall be selected based on pole/mounting height, coverage area, and shall be suitable for operation in the ambient temperatures typically found for the intended installation. Luminaire shall be compatible with bi-level switching operation.

2.05 FUSES

A. Furnish and install a fuse holder and fuse in each ungrounded leg of the electrical circuit supplying the outdoor luminaire. If the voltage is 208, 240, or 480 volts, then the fuse holder needs to be a 2-pole fuse holder which simultaneously disconnects both ungrounded conductors. Every luminaire (including bollards) shall be separately fused with a water-resistant fuse holder. Size the fuse for the amperage of the luminaire. Tap the circuit conductors with a minimum #10 AWG conductor to serve the luminaire. The fuse and holder shall be accessible through the handhole. Provide sufficient wire to bring fuse holder outside of handhole.

2.06 WIRING CONNECTORS

A. Wiring Connectors shall meet the requirements of Section 26 05 19 Wiring/Cable, 600 Volts and Under.

B. Twist-On Wire Connectors: Solderless twist-on spring connectors (wire-nuts) with insulating covers for copper wire splices and taps. All wire connectors used in site lighting applications shall be silicone gel-filled twist connectors or connectors designed for damp and wet locations. Gel-filled twist-on connectors may be used for copper conductor sizes 6 AWG and smaller for site lighting applications. The manufacturer's wire fill capacity must be followed.

2.07 POLES

A. Provide poles designed for wind loading of 100 miles per hour determined in accordance with AASHTO LTS2 while supporting luminaires having effective projected areas indicated. Poles shall be anchor base type designed for use with overhead supply conductors.

B. Concrete Poles: Provide concrete poles conforming to PCI JR275 5/6 and as follows:

1. Steel Reinforcing: Prestressed concrete pole shafts shall be reinforced with steel prestressing members. The design shall provide internal longitudinal loading by either pretensioning or posttensioning of the longitudinal reinforcing members.
2. Primary Reinforcing: Primary (Longitudinal) reinforcing steel used in prestressed concrete poles shall be high strength, stress relieved uncoated wire type, either stranded or solid in accordance with ASTM A416 or ASTM A421.
3. Supplementary Reinforcing: Supplementary reinforcing steel, if required, may be of either high strength or of medium strength steel in accordance with ASTM A416 (75,000 psi min).
4. Tensioned Reinforcing: The primary reinforcement steel used for a prestressed concrete pole shaft shall be tensioned to 60 percent to 70 percent of its ultimate strength. The amount of reinforcement shall be such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.
5. Coating and Sleeves For Reinforcing Members: Reinforcing steel shall be spaced and secured so as to insure a minimum concrete coverage of 1/2 inch thickness. Where minimum internal coverage cannot be maintained next to required core openings, such as handhole and wiring inlet, the reinforcing shall be protected with a vapor-proof noncorrosive sleeve over the length without the 1/2 inch concrete coverage. Each steel reinforcing member which is to be posttensioned shall have a non-migrating slipper coating applied prior to the addition of concrete to insure the uniformity of stress throughout the length of such member.

6. Cement Mix: The cement used for the concrete shall be Portland cement in accordance with ASTM C150. Types I or III shall be used for general service. However, if resistance to sulfates is necessary, Portland cement Types II or V may be substituted.
7. Aggregate: The aggregate used for the concrete shall be fine grade, either natural or artificial. Natural aggregate shall conform to ASTM C33, fine grade except that five to ten percent shall be retained by a number 4 sieve. Artificial aggregates shall conform to applicable sections of ASTM C33 and ASTM C330 regarding size and strength. Either type shall have been proven for the following:
   a. Moisture absorption, two percent maximum of weight.
   b. Good resistance to abrasion.
8. Water: The water used for concrete shall be clean and free of injurious quantities of substances deleterious to concrete or to prestressing steel.
9. Strength Requirement: The proportions of cement, aggregate, and water for the concrete, and the processing and curing of the concrete, shall be such as to develop a minimum compressive strength of 3500 psi before stress transfer in prestressing. Further natural curing shall achieve a 28 day compressive strength of 7000 psi. Poles shall not be subjected to severe temperature changes during the curing period.
10. Shaft Preparation: The completed prestressed concrete pole shaft shall be clean, smooth, and free of surface voids and internal honeycombing.

C. Aluminum Poles: Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS2 for Alloy 6063 T6 or Alloy 6005 T5 for wrought alloys and Alloy 356 T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire.

D. Steel Poles: AASHTO LTS2. Provide steel poles having minimum 11 gage steel with minimum yield/strength of 48,000 psi and hot dipped galvanized per ASTM A123factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire.

E. Wood Poles: ANSI O5.1 of Southern Yellow Pine. Poles shall be gained, bored, and roofed before treatment. Poles shall be treated full length with chromated copper arsenate (CCA) or Ammoniacal Copper Arsenate (ACA) according to AWPA C4.

F. Handhole: With removable weatherproof cover.

G. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole.

2.08 FOUNDATIONS

A. Provide foundations for poles, bollards, and ground-mounted flood and accent lighting. Construct from reinforced concrete in sizes as shown on drawings and to meet the minimum structural requirements of SPS 362.1807 Shallow Post Foundations, and IBC 1807.3 Embedded Posts and Poles.

B. Place the anchor bolts in pole bases so that the luminaire will be oriented perpendicular to the curb/street/sidewalk/parking lot or as indicated on the plan.
   1. Provide a concrete-encased electrode (UFER) grounding system for grounding the foundation, luminaire, and pole:
   2. Provide twenty-five (25) feet of #4 bare stranded copper grounding electrode conductor.
   3. Extend three (3) feet of the grounding electrode conductor out the top of the foundation for connection to the luminaire/pole.
   4. Clamp the grounding electrode conductor to the top of the rebar cage. Use a clamp rated for such use such as an Erico EK16 or similar.
   5. Spiral a minimum of ten (10) feet of the grounding electrode conductor around the outside of the rebar cage.
   6. Loop the remaining conductor around the rebar cage at the bottom of the foundation in direct contact with earth.

C. The exposed surface area of the foundation shall have the forms removed and the concrete rubbed out to a smooth finish.

D. Pole Base J-Boxes: For pole bases with multiple conduits to other poles/locations, the contractor may provide a non-metallic j-box with a curved cover mounted in the side of the exposed part of the base to accommodate the multiple conduits. Boxes shall be NEMA 3R Carlon Nonmetallic Curved Lid J-Boxes or equal. Mount j-box centered at 20” above grade. Use only in poles 18” in diameter and larger. Locate boxes 90-degrees or 180-degrees from traffic. Install boxes per manufacturer’s recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Wood Poles: Stack poles stored for more than 2 weeks on creosoted or decay resisting skids arranged to support the poles without producing noticeable distortion. Pile poles to permit free circulation of air; the bottom poles of the piles shall be at least 1 foot above ground level or any growing vegetation. Do not permit decayed or decaying wood to remain underneath stored poles. Do not drag treated poles along the ground. Do not use pole tongs, cant hooks, and other pointed tools capable of producing indentation more than 1 inch in depth in handling the poles. Do not apply tools to the ground line section of any pole. The ground line section is that portion between 1 foot above and 2 feet below the ground line.

B. Aluminum and Steel Poles: Provide anchor bases with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Thoroughly compact backfill with compacting arranged to prevent any pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. After installation, paint the exposed surfaces of steel poles with two finish coats of exterior oil paint of a color as indicated.

C. Pole Setting: Depth shall be as indicated. Dig holes large enough to permit the proper use of tampers to the full depth of the hole. Place backfill in the hole in 6 inch maximum layers and thoroughly tamp. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.

D. Install in accordance with manufacturers' instructions.

E. Minimum underground conduit size is 1 inch unless otherwise indicated.

F. Underground and exterior wire shall be minimum #8 AWG conductors, type XHHW-2 or USE-2. #10 AWG conductors shall be utilized for vertical wire installed within pole and for overall circuit lengths of less than 100 LF.

G. Protect anchor bolts 2 inches (50 mm) minimum above base.

H. Install all anchor bolts and handhole fasteners with anti-seize compound.

I. Install poles plumb. Provide shims or double nuts to adjust plumb.

J. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

K. Bond each luminaire, each metal accessory, the ground rod and the pole to the branch circuit equipment ground conductor with a separate ground wire sized per NEC or as shown on the drawings.

L. Dimmed luminaire circuits shall have separate neutrals.

M. Dimmed luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires do not “glow” at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to Engineer.

3.02 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

3.03 ADJUSTING

A. Aim and adjust luminaires as indicated on drawings or as required to meet the performance specifications.

B. All new lamps shall be operational at the Substantial Completion of the project.

C. Adjust motion sensors to provide proper coverage for bi-level switching operation.

3.04 CLEANING

A. Clean photometric control surfaces.

B. Clean finishes and touch up damage.

END OF SECTION

SECTION 28 01 00

INTERIOR FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Interior Fire Alarm System, as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. Factory Mutual System (FM) Publication:
      a. Approval Guide
   2. Federal Communications Commission (FCC) Publication:
      a. 47 CFR Rules and Regulations
      b. Part 90
   3. Federal Standard (Fed. Std.):
      a. FED-STD-595A Color (Requirements for Industrial Color & Notice 6 Chips)
   4. National Electrical Manufacturers Association (NEMA) Publication:
      a. ICS 1 Industrial Control and Systems
   5. National Fire Protection Association (NFPA) Publications:
      a. 70 National Electrical Code
      b. 72A Local Protection Signaling Systems
      c. 72B Auxiliary Protective Signaling Systems
      d. 72E Automatic Fire Detectors
      e. 74 Household Fire Warning Equipment
      f. 1221 Public Fire Service Communications
   6. Underwriters Laboratories Inc. (UL) Publication:
      a. Fire Protection Equipment Directory

1.03 QUALIFICATIONS OF INSTALLER:

A. Prior to installation, submit data for approval by the Engineer showing that the Contractor has successfully installed interior fire alarm systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. The Contractor shall

indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

B. Manufacturer's Representative: Furnish the services of a qualified fire alarm system manufacturer's representative or technician, experienced in the installation and operation of the type of system being provided, to supervise the testing, including formal testing, adjustment of the system, and instruction to Government personnel.

1.04 GENERAL REQUIREMENTS

A. Section 26 05 01, "Electrical General Requirements", applies to this Section, with the additions and modifications specified herein.

B. Equipment shall be provided as vandal resistant where indicated on Contract Drawings.

1.05 DESCRIPTION OF WORK

A. The work includes providing new interior fire alarm system devices including associated equipment and appurtenances to existing fire alarm system. Provide each system complete and ready for operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 72A and NFPA 72E, except as modified herein. Devices and equipment for fire alarm service shall be listed by Underwriters' Laboratories, Inc., or approved by the Factory Mutual System. In the NFPA publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Provide wiring materials under this Section as specified in Sections 26 05 19, "Wiring Cable 600 Volts and Under", 26 05 34, “Conduit”, and 26 05 35. “Outlet, Junction, and Pull Boxes” with the additions and modifications specified herein. Equipment and devices shall be compatible and operable in all respects with existing station fire alarm system and shall not impair reliability or operational functions of existing station fire alarm system. Existing station fire alarm system supplied by International Built In Systems, Inc. Contact information is (518) 459-3993. Furnish materials and equipment that are current products of one manufacturer regularly engaged in the production of such equipment.

1.06 SUBMITTALS

A. Shop drawings and descriptive data shall be approved prior to procurement, fabrication, and installation.

B. Manufacturer's Data:
   1. Heat Detectors
   2. Smoke detectors
   3. Power Booster Panel
   4. Horn and Strobes
   5. Manual Pull Stations

C. Shop Drawings: Provide drawings that clearly and completely indicate the function of the control panel and devices connected thereto. Indicate termination points of devices and indicate the interconnection of modules required for proper operation of the system. Indicate interconnection between modules and devices connected thereto.

D. Calculations: Verify that battery capacity exceeds supervisory and alarm power requirements.

E. Operation and Maintenance Manual: Provide six copies, bound securely in durable, hard cover, water-resistant binders. Include instructions for operating and maintaining system components, assemblies, and accessories; include a detailed description of the control panel and system operation under both routine and emergency conditions. Include as-built circuit diagrams complete with conductor color codes, a parts list by name, model number, and manufacturer, and a listing of smoke detector locations, with the serial number and firing voltage for each. General system descriptions included in manufacturer's catalogs or advertising media will not be acceptable in meeting the operation and maintenance manual requirement.

1.07 SPARE PARTS

A. Spare parts shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, stamping, or tagging. Keys and locks for equipment shall be identical where possible. Furnish the following:
   1. One key or tool for resetting manual stations
   2. One key for lock of control panels or cabinets
   3. One of each type heat detector
   4. One of each type smoke detector

PART 2 - PRODUCTS

2.01 SYSTEM DESIGN

A. Wiring: Provide in accordance with NFPA 70 and NFPA 72A. Conductors shall be copper. Conductors for 120-volt circuits shall be No. 12 AWG minimum; single conductors for low-voltage dc circuits shall be No. 14 AWG minimum. Conductors shall be color-coded.

1. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage. Conceal conduit in finished areas of new construction and wherever practicable in existing construction. Identify conductors within each enclosure where a tap, splice, or termination is made. Identify conductors by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Wire the alarm initiating and notification signal devices so that removal will cause the system trouble device to sound. Pigtail or "T" tap connections to alarm initiating devices, evacuation alarm bells, horns, and fire warning light are not acceptable. Each conductor used for the same specific function shall be distinctively color coded. Use two different color codes for each interior alarm circuit; one for each loop. Each circuit color code wire shall remain uniform throughout circuit.

2.02 COMPONENT DESIGN

A. Colors: Provide finish colors under this Section in accordance with Fed. Std. FED-STD-595.

B. Manual Stations: Provide non-coded type with mechanical reset features. Locate stations as indicated. Stations shall be surface -mounted. Surface-mounted boxes shall be painted the same color as the alarm station. Provide each station with screw-type terminals of proper number and type to perform functions required. Break-glass-front stations will not be permitted; however, a pull-lever, break-glass-rod type is acceptable.

C. Smoke Detectors: Designed for detection of abnormal smoke densities by the ionization principle. Control or power panels required for operation of the device shall be provided either as individual units or integral with existing main control panel. Detectors and associated panels shall be compatible with main control panel that is provided and shall be suitable for use in a supervised circuit. Malfunction of the electrical circuitry to the detector or detector control or power units shall actuate the system trouble devices. Detector spacing and location shall be in accordance with manufacturer's recommendations, the requirements of NFPA 72E, and as indicated. Each detector shall contain an alarm lamp which

shall illuminate when the detector is activated into an alarm condition. Detector base shall be provided with screw-type terminals for wiring connections.

1. Ionization Detectors: Multiple chamber type which is responsive to both invisible and visible particles of combustion. Detectors shall not be humidity sensitive. The sensitivity of each detector shall be field adjustable to compensate for operating conditions.
2. Duct Smoke Detectors: Detectors in ducts shall be ionization type and listed by UL or FM for duct installation. Duct detectors shall be provided with approved duct housing, mounted exterior to the duct, and shall be provided with perforated sampling tubes extending across the width of the duct.

D. Heat Detectors: Designed for high temperature. Control or power panels required for operation of the device shall be provided either as individual units or integral with the main control panel. Detectors and associated panels shall be compatible with existing main control panel and shall be suitable for use in a supervised circuit. Malfunction of the electrical circuitry to the detector or detector control or power units shall actuate the system trouble devices. Detector spacing and location shall be in accordance with manufacturer's recommendations, the requirements of NFPA 72E, and as indicated. Each detector shall contain an alarm lamp which shall illuminate when the detector is activated into an alarm condition. Detector base shall be provided with screw-type terminals for wiring connections.

1. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
2. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
3. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155- deg F.
4. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15- deg F or 20- deg F per minute. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F

E. Alarm Bells: Provide surface-mounted type with matching back box. Provide under dome vibrating type bells, suitable for use in an electrically-supervised circuit, with a sound output rating of at least 90 decibels at 10 feet. Bells shall have a separate screw terminal for each conductor connection.

F. Alarm Horns: Provide surface-mounted, vibrating type, suitable for use in an electrically-supervised circuit. Horns shall have a minimum sound output rating of at least90 decibels at 10 feet. Horns in locations exposed to the weather shall be approved weatherproof type.

G. Audiovisual Alarms: Provide surface-mounted approved audiovisual alarm devices consisting of a vibrating type alarm horn suitable for use in an electrically- supervised circuit and top-mounted integral flashing strobe light. Horn shall have a sound rating of at least 90 decibels at 10 feet. Strobe light shall have a ruby-colored lens.

H. Visual Alarms: Provide surface-mounted lamp assembly suitable for use in an electrically-supervised circuit. Provide lamps of the flashing stroboscopic type, powered from the control panel alarm circuit. Lamps shall produce a minimum of 50 candlepower and flash between 60 and 120 times per minute. Lamps shall be protected by a red, thermoplastic lens and shall be labeled FIRE.

I. Grounding: Each device shall be grounded by connection from the grounding terminal connection of the box to either a driven ground rod or a buried, metallic water pipe. Resistance to ground shall not exceed 10 ohms.

1. Ground Rods: Provide copper-weld type copper clad steel rods with diameter adequate to permit driving to full length of the rod, but not less than 0.75 inch in diameter and 10 feet long unless otherwise indicated. Ground rods shall not protrude more than 6 inches above grade.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment, materials, installation, workmanship, inspection, and testing shall be in accordance with NFPA publications and as modified herein.

3.02 PRELIMINARY TESTS

A. Conduct the following tests during installation of wiring and system components. Correct any deficiency pertaining to these requirements prior to formal functional and operational tests of the system.

B. Ground Resistance: Measure the resistance of each connection to ground. Ground resistance shall not exceed 10 ohms.

C. Dielectric Strength and Insulation Resistance: Test the dielectric strength and the insulation resistance of the system interconnecting wiring by means of an instrument capable of generating 500 volts dc and equipped to indicate leakage current in 1000 meg ohms. For the purpose of this test, the instrument shall be connected between each conductor on the line and between each conductor and ground at the control panel end of the line, with the other extremity open circuited and all series-connected devices in place. The system shall withstand the test without breakdown and shall indicate a resistance of not less than 500,000 ohms,

the measurement being taken after an electrification of not more than 1.0 minute with a dc potential of not less than 100 volts nor more than 550 volts.

D. Smoke Detector Tests: Prior to formal inspection and tests, clean and perform sensitivity tests on each smoke detector. Clean the smoke detectors in accordance with the manufacturer's recommended procedures. Perform voltage activation sensitivity test on each detector and record the results. Remove detectors with a sensitivity level above or below the UL accepted sensitivity range for that detector and replace with new detectors. Present recorded data at the formal inspection for verification. Approved copies shall become part of the operations and maintenance manual for the fire alarm system.

3.03 FIELD INSPECTION AND TEST

A. Before final acceptance of the work, test each system to demonstrate compliance with the contract requirement. Each system shall be subjected to complete functional and operational tests including tests in place of each beam and smoke detector. When tests have been completed and corrections made, submit a signed and dated certificate with a request for formal inspection and tests.

3.04 FORMAL INSPECTION AND TEST:

A. The owner will witness formal tests after receipt of written certification that preliminary tests have been completed and that the system is ready for final inspection. The system manufacturer's technical representative shall be present for the final inspection and test. Preliminary tests shall be repeated, and functional and operational tests conducted, as requested by the Owner or Technical Representative. Correct defects and conduct additional tests to demonstrate that the system conforms to contract specifications.

END OF SECTION

SECTION 31 05 16

AGGREGATES FOR EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes material requirements and gradations for all unbound aggregates, as called on the Plans.

B. Aggregate mixes including in this specification include:
   1. Granular Fill.
   2. Pipe Bedding.
   3. Structural Fill.
   4. Drainage Fill.
   5. Select Granular Fill.
   6. Sand Fill.

C. Related work specified elsewhere:
   1. Section 31 05 19.24, Geotextiles.
   2. Section 31 23 43, Excavating, Backfilling and Compacting.
   3. Section 31 25 00, Erosion and Sediment Control.
   4. Section 32 12 16, Asphalt Paving.

1.02 REFERENCES

A. The following is a list of standards that may be referenced in this Section:
   1. American Association of State Highway Transportation Officials (AASHTO):
      a. M147, Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
      b. T180, Standard Specification for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18-in. Drop.
   2. ASTM International (ASTM):
      a. C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
      b. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
      c. D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).
      d. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3).
      e. D2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

f. D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.03 SUBMITTALS

A. Materials Source: Name of imported materials suppliers.

1.04 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout work.

PART 2 – PRODUCTS

2.01 GENERAL

A. All granular materials shall be free from any organic or other deleterious materials.

B. The quality of the gravel or stone particles shall be demonstrated per ASTM C88.

C. The maximum weight loss at four (4) cycles shall be 20 percent.

2.02 MATERIALS

A. Granular Fill: Conforming to New York State Department of Transportation Standard Specifications Item 304.12 Type 2 Subbase Course.

B. Pipe Bedding:
1. Shall consist of clean, sound, crushed stone and shall be free from coatings.
2. Conform to NYSDOT 703-02 for coarse aggregate requirements.
3. NYSDOT No 1 Stone Gradation (703-4):
   a. Percent passing by weight per sieve size:
      1) 1 inch: 100.
      2) 1/2 inch: 90 to 100.
      3) 1/4 inches: 0 to 15.
      4) No. 200: 0 to 1.0.

C. Structural Fill:
1. Shall consist of crushed gravel or crushed stone.
2. The gravel or stone shall be well graded from fine to coarse.

3. Shall conform to NYSDOT 703-02 for coarse aggregate requirements and NYSDOT 703-4 No.2 Stone Gradation:
    a. Percent passing by weight per sieve size:
        1) 1-1/2 inch: 100.
        2) 1 inch: 90 to 100.
        3) 1/2 inch: 0 to 15.
        4) No. 200: 0 to 1.0.

D. Drainage Fill:
1. Natural stone pea gravel, washed**,** free of clay, shale, organic matter; graded according to ASTM C136; to following limits:
    a. Minimum Size: 1/8 inch.
    b. Maximum Size: 3/8 inch.

E. Select Granular Fill: Conforming to New York State Department of Transportation Standard Specifications Item 733-11.

F. Sand Fill:
1. Clean, granular sand, free from organic matter and frozen material.
2. Maximum particle size:
    a. 4-inch diameter pipe and smaller: 1/2-inch.
    b. 6-inch to 8-inch diameter pipe: 3/4-inch.
    c. 10-inch to 15-inch diameter pipe: 1-inch.
    d. 16-inch diameter and larger: 1-1/2-inch.
3. Conforming to New York State Department of Transportation Standard Specifications Item 733-15.

2.02 SOURCE QUALITY CONTROL

A. Coarse Aggregate Material, Testing and Analysis: Perform sieve analysis, plasticity index, and soundness tests in accordance with ASTM C136, ASTM D4318.

B. When tests indicate materials do not meet specified requirements, change material and retest at the Contractor’s expense.

PART 3 – EXECUTION

3.01 HAULING MATERIAL

A. When it is necessary to haul material over the streets or pavements, the Contractor shall provide suitable tight vehicles so as to prevent deposits on the streets or pavements.

B. In all cases where any materials are dropped from the vehicles, the Contractor shall clean up the same at least daily or as often as directed and keep the crosswalks, streets and pavements clean and free from dirt, mud, stone and other hauled material.

3.02 STOCKPILING

A. Stockpile materials on Site at locations designated on the drawings, the SWPPP, or as otherwise approved by the Engineer.

B. Stockpile in sufficient quantities to meet project schedule and requirements.

C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

E. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.03 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition.

B. Grade site surface to prevent free standing surface water.

C. When borrow area is indicated, leave area in clean and neat condition.

D. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 05 19.24

GEOTEXTILES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials, and equipment for the installation of Geotextile as shown on the Plans, as specified, and/or directed.

1.02 REFERENCES

A. Geosynthetic Research Institute, GT12(a) “Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials (ASTM),” Revision 2, March 3, 2016.

B. Geosynthetic Research Institute, GT13(a) “Test Methods and Properties for Geotextiles Used as Separation Between Subgrade Soil and Aggregate (ASTM),” Revision 4, June 20, 2017.

1.03 SUBMITTALS

A. Prior to the installation or delivery of a geotextile, the Contractor shall submit to the Engineer, from the geosynthetic manufacturer, a list of guaranteed "minimum average roll values" (MARV) for the geotextile (the minimum average roll value is the minimum value obtained from the average values of the sampled rolls). The Contractor shall provide, from the manufacturer, a written certification stating that the geosynthetic material meets or exceeds the guaranteed properties submitted.

B. In addition to submitting guaranteed physical properties, the Contractor shall submit to the Engineer, from the manufacturer, documentation demonstrating the chemical compatibility of the geosynthetic material with leachate generated from mixed municipal solid waste. Such documentation shall include chemical compatibility testing results, if requested by the Engineer.

C. Prior to delivery of the geotextile, the Contractor shall submit a sample of the material and installation warranty to be provided as described in Article 3.03.

D. The Contractor shall submit to the Engineer, from the manufacturer, documentation certifying that all Type 4 geotextiles provided by the Contractor have been inspected for needles and sheet defects, such that no needles or defects are present in rolls shipped to the site. Documentation must be provided by the manufacturer certifying that each roll of Type 4 geotextile has been inspected for the presence of broken needles using an in-line metal detector.

1.04 DELIVERY, STORAGE, AND HANDLING

A. All geotextiles will be inspected on delivery, and materials that do not comply with the Specification will be rejected. The Contractor shall furnish all labor required to handle the geotextiles during inspection and shall remove the rejected material from the site. Stockpiling of geosynthetics, specifically allowable height and surfaces, shall be in accordance with the manufacturer's recommendations.

1.05 CONFORMANCE TESTING

A. Conformance samples shall be taken at the manufacturing facility unless otherwise approved by the Engineer. All conformance test results shall be submitted a minimum of seven days prior to installation. No materials shall be installed until acceptable test results are approved by the Engineer.

B. If samples are taken on-site, sampling shall occur within one week of delivery at the Engineer's direction. The Contractor shall provide the necessary labor, tools, and equipment to obtain samples from all supplied materials at the specified frequency to an independent quality assurance laboratory for testing.

C. At a minimum, the following tests will be performed on Type 1, Type 2, and Type 4 geotextiles:
   1. mass per unit area - ASTM D5261
   2. grab strength - ASTM D4632
   3. CBR Puncture Resistance - ASTM D6241
   4. trapezoidal tear strength - ASTM D4533

D. Samples will be taken by cutting along the width and 5 feet from the end of a rolled or folded geotextile material. The sampling frequency for the geotextile will be one sample per every 100,000 square feet of respective material delivered. The samples shall be evenly distributed throughout the rolls delivered to the site.

E. Any samples which fail the conformance testing will require the failed material to be removed from the site. The failing material shall be isolated by taking samples from rolls prior to and after the failing roll.

F. For each lot number of geotextile (Type 1, Type 2 and Type 4) that arrives at the site, a sample shall be taken by the Contractor and provided to the Owner for archiving. This sample shall be 3 feet long by the width of the roll. The Contractor shall nearly package the samples and label the specific roll information and project as directed by the Engineer.

G. Conformance testing for Type 3 Geotextile is not required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Geotextile:

1. Type 1, Type 2 and Type 4 geotextile shall be nonwoven, needle-punched, polymeric geotextile. Type 3 geotextile shall be woven geotextile. The fibrous structure of the geotextile must be able to withstand handling, placement and long-term loads associated with the installation.
2. All geotextile shall be protected from ultraviolet light, precipitation, mud, dirt, excessive dust, puncture, cutting and/or other damaging condition prior to and during delivery. All geotextile shall be capable of withstanding 30 days of sunlight without measurable deterioration.
3. Fabrics shall be similar materials except for the weight and the associated physical properties. Type 1 will be nominal eight oz./square yard or heavier and Type 2 will be a nominal sixteen oz./square yard or heavier fabric. The Type 4 geotextile will be nominal twenty-four oz./square yard or heavier. An equivalent substitution may be made subject to the approval of the Engineer. Geotextile Specifications are given in Article 2.02.
4. One type of woven geotextile will be supplied by the Contractor for use in roadway construction. Type 3 geotextile shall be Mirafi 600X, or an approved equal.
5. All geotextiles shall be delivered on site shall be tagged and display the following information.
    a. Manufacturer's name
    b. Product identification
    c. Lot number
    d. Roll number and dimensions

2.02 MANUFACTURER’S QUALITY CONTROL DATA

A. Geotextile Specifications:

1. The table below lists the MARV specification values for the geotextiles to be used for the project. In addition, the typical average specification values, as indicated, have been listed. Final approval of the geotextile properties shall be made by the Engineer based upon Contractor's submittals.

Geotextiles

Specification Limits:

Property	Type 1	Type 2	Type 3	Type 4	Test Method
*Mass per Unit Area (oz/yd^2)	8.0	16.0	N/A	24.0	ASTM D5261
**Apparent Opening Size (US Sieve)	70-100	80-100	40	100	CW-02215 or ASTM D4751
*Grab Strength (lbs)	205	370	315	450	ASTM D4632
*Grab Elongation (%)	50	50	15	50	ASTM D4632
*CBR Puncture Resistance (lbs)	535	900	900	1100	ASTM D6241
*Trapezoidal Tear Strength (lbs)	85	145	110	200	ASTM D4533
*Permittivity (sec^{-1})	1.35	0.6	0.05	0.4	ASTM D4491
***Ultraviolet Stability (% Str. Ret. @ 500 hrs)	70	70	70	70	ASTM D7238

*MARV Values Taken Along Weakest Principal Direction.
**Typical Average Values
***Evaluation to be on 2.0 inch strip tensile specimens after 500 hours exposure
N/A = Not Applicable

PART 3 - EXECUTION

3.01 INSTALLATION

A. The following procedures and requirements will be followed during the installation of geotextile.

B. Placement

1. The placement of the geotextile shall not be conducted during weather conditions that would compromise the installation of the material or underlying materials. The geotextile will be kept dry during storage and up to the time of deployment. During windy conditions, all geotextiles will be secured with sandbags or an equivalent approved anchoring system. Removal of the sandbags or equal will only occur upon placement of an overlying soil layer.
2. Tools appropriate for cutting geotextile as approved by the Engineer shall be used to cut and size the geotextile materials. Extreme care will be taken while cutting in-place geotextiles.
3. During the placement of geotextiles, all dirt, dust, sand or mud shall be kept off to prevent clogging. If excessive contaminant materials are present on the geotextile, it shall be cleaned or replaced as directed by the Engineer.

4. No equipment used will damage the geotextiles by handling, trafficking or other means. Equipment, including ATVs, will not be allowed to travel directly on the geotextiles during the installation of overlying soils or geosynthetic layers, unless otherwise approved by the Engineer. Any damage to the material from the equipment shall be repaired by the Contractor at no additional cost to the Owner.
5. The Contractor shall perform field needle detection with a magnetic locator for all Type 4 geotextile rolls installed. Each roll shall also be visually inspected for sheet defects prior to primary collection layer placement.

C. Seaming or Joining
1. Geotextiles shall be seamed using either an eighteen inch overlap, by sewing or by fusion welding. The specific conditions requiring a sewn/welded seam or simply an overlap are as follows:
   a. Type 1, Type 2, and Type 3 geotextile shall be sewn or overlapped according to the criteria below. Type 4 geotextile shall be fusion welded with an appropriate welding machine, sewn or overlapped.
   b. In all cases, seams on side slopes will be parallel to the line of slope. No horizontal seams will be allowed on side slopes, except for patching.
   c. Geotextiles placed on the subgrade, or between two soil layers at less than 10 percent slope may utilize an 18-inch overlap seam.
   d. Where the slope is greater than 10 percent, and/or directly above a geomembrane, these seams shall be sewn or fusion welded.
2. Sewing will be done using a polymeric thread with chemical compatibility resistance equal to or exceeding the geotextile being sewn. Thread and the sewing device shall be approved by the Engineer prior to its use in the field.
3. Repair of tears or holes in the geotextile will require the following procedures:
   a. On slopes: A patch made from the same geotextile will be double seamed into place; with each seam 1/4-inch to 3/4-inch apart and no closer than 1-inch from any edge. Should any tear exceed 10% of the width of the roll, that roll will be removed from the slope and replaced.
   b. Flat slopes: A patch made from the same geotextile will be spot-seamed in place with a minimum of 24-inch overlap in all directions or sewn in-place as allowed on sloping areas.

3.02 WARRANTY

A. The Contractor shall obtain and submit to the Engineer from the manufacturer and installer separate written warranties for the geotextiles. The warranty shall guarantee that the material and workmanship shall remain free from defects for a minimum of one (1) year from the date of substantial completion of the project. The Engineer will review the warranty for completeness prior to the Owner accepting its provisions.

END OF SECTION

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall prepare and clear from the site of the work, by removal or destruction, as may be required, the following:
   1. Debris
   2. Brush
   3. Logs
   4. Trees
   5. Stumps
   6. Snow and Ice
   7. Refuse and Rubbish

B. The work also includes:
   1. Removal and replacement, as required, or supporting of all telephone and power posts, poles and lines within the work area.
   2. Any work to be performed specifically to be paid for under the Clearing Item as stated in the Information For Bidders and/or the Additional Instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The Contractor shall furnish and install materials and equipment required.

PART 3 - EXECUTION

3.01 REMOVAL

A. The Contractor shall furnish all labor, material and equipment necessary to properly construct all items under this Section in an acceptable manner.
   1. No burning or burying of brush, logs, trees, stumps or other debris will be allowed on the site.
   2. All merchandise timber must be salvaged and turned over to the Owner.
   3. The Contractor shall remove all brush, slash and toppings, and dispose with stumps at a location approved by the Owner.

END OF SECTION

SECTION 31 23 16.13

TRENCHING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
1. Excavating trenches for utilities as indicated on the Plans, or as directed by Engineer.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.
4. Excavation for associated site structure such as manholes, inlets, and catch basins are specified in Section 31 23 43, Excavating Backfilling and Compacting.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM):
1. ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3).
2. ASTM D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).
3. ASTM D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

B. Occupational Safety and Health Administration (OSHA):
1. 29 CFR 1926.650, Safety and Health Regulations for Construction.

1.03 SUBMITTALS

A. Comply with Submittal Procedures.

B. Action submittals:
1. Report and certification of gradation for each type of fill.
2. Field density reports.
3. One optimum moisture-maximum density curve for each type of fill.

1.04 DEFINITIONS

A. Utility: A buried pipe, duct, conduit, or cable.

B. Pipe Zone: trench fill zone between the bottom of the pipe and the top of the pipe extending for the entire trench width.

1.05 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

A. Concrete: Comply with Section 03 30 00, Cast-in-Place Concrete.

B. Structural Fill: Comply with Section 31 05 16, Aggregates for Earthwork.

C. Granular Fill: Comply with Section 31 05 16, Aggregates for Earthwork.

D. Pipe Bedding: Comply with Section 31 05 16, Aggregates for Earthwork.

2.02 ACCESSORIES

A. Geotextile Fabric: as specified in Section 31 05 19.13, Geotextiles for Earthwork.

PART 3 - EXECUTION

3.01 LINES AND GRADES

A. Lay utilities to lines and grades indicated on drawings.

B. Engineer reserves the right to changes in lines, grades, and depths of utilities when changes are required for Project conditions.

C. Use laser-beam instrument with qualified operator to establish lines and grades.

3.02 PREPARATION

A. Mark all planned excavations with white paint.

B. Comply with 16 NYCRR 753 and call Dig Safely New York at 811 not less than three (3) working days before performing Work.

C. Request underground utilities to be located and marked within and surrounding construction areas.

D. Identify required lines, levels, contours, and datum locations.

E. Protect plant life, lawns, and other features remaining as portion of final landscaping.

F. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

G. Maintain and protect above and below grade utilities indicated to remain.

H. Establish temporary traffic control when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.03 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove lumped subsoil, boulders, and rock up of 1/6 cubic yards, measured by volume. Remove larger material as specified in Section 31 23 16.26, Rock Removal.

C. All excavations within 24 inches of existing water, gas, or electric lines shall be performed according to Dig Safely New York requirements.

D. Do not advance open trench more than 300 feet ahead of installed utility, nor leave unfilled for more than 100 feet in the rear thereof without consent of the Engineer.

E. Excavation of the trench shall be fully completed at least 20 feet in advance of the utility installation, unless specifically permitted otherwise.

F. Trenches shall not be left opened overnight.

G. Cut trenches sufficiently wide to enable installation and allow inspection.

H. Remove water or materials that interfere with Work.

I. Excavate bottom of trenches minimum 6 inches wider than outside diameter of pipe on each side.

J. Width of trenches, measured at a point 12 inches above the top of the pipe shall not exceed 12 inches on each side.

K. Where, as required by loading conditions, the width of the lower portion of the trench, measured at twelve (12) inches above the top of the pipe, exceeds the maximum for the pipe, additional concrete cradle or concrete encasement shall be installed by the Contractor.

L. Ledge rock, shale, boulders and large stones shall be removed to provide minimum bottom and side clearances, for the size of pipe being laid in each case, as follows:

1. Minimum clearance:
    a. Below pipe: 6 inches.
    b. At sides: 6 inches.

M. Where concrete embedment or cradle is to be placed, it shall be placed directly on the rock, and the bottom clearance shall be adjusted as directed by the Engineer.

N. Excavate trenches to depth indicated on Contact Drawings. Provide a flat bottom with uniform and continuous bearing and support for bedding material, piping and/or utilities.

O. Do not interfere with 45-degree bearing splay of foundations.

P. When Project conditions permit, slope side walls of excavation starting 24 inches above top of pipe.

Q. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this Section.

R. Unsuitable subgrade:
1. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered.
2. Cut out soft areas of subgrade not capable of compaction in place as directed by Engineer and place a single layer of reinforcing geotextile fabric to cover the entire over-excavated surface area.
3. Backfill with structural fill.

S. Except where concrete cradle or encasement is required below the specified pipe subgrade, mechanical excavation of trenches for utility shall not extend lower than one (1) inch above the finished pipe subgrade elevation at any point.

T. Hand trim for bell and spigot pipe joints. Remove loose material. Grade bottom of trench by hand to be specified line and grade with proper allowance for pipe thickness and pipe base.

U. All trenches shall be so graded that the spigot end of the pipe will be accurately centered in the adjacent pipe bell when laid, without raising the pipe off the trench bottom.

V. Re-grading of a trench bottom which is too high will be permitted. Correction of a subgrade that is too low shall be done only by placing and compacting pipe bedding in accordance with Section 31 05 16, Aggregates for Earthwork over the entire width of the trench and regrading.

W. Trench bottom shall form a continuous and uniform bearing and support for pipe between bell holes.

X. Concrete encasement:
   1. Where concrete cradle or encasement is required, the trench subgrade elevation will be determined by the required concrete section in each case.
   2. Unless otherwise authorized by the Engineer, concrete cradle or encasement shall extend across the full width of the trench as excavated, and the concrete therein shall be poured directly against vertical trench banks.
   3. In the case of concrete cradle or encasement of pipe in a sheeted trench, the concrete may be poured directly against sheeting which is to be left in place in the trench, as specified.

3.04 TRENCH WIDTH

A. Minimum width of trenches:
   1. Single pipes, conduits, direct-buried cables, and duct banks:
      a. Less than 4-inch outside diameter or width: 18 inches.
      b. Greater than 4-inch outside diameter or width: 18 inches greater than outside diameter or width of pipe, conduit, direct-buried cable or duct bank.
   2. Multiple pipes, conduits, cables or duct banks in a single trench: 18 inches greater than aggregate width of pipes, conduits, cables duct banks, plus space between.
   3. Increase trench widths by thickness of sheeting.

B. Maximum trench width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

3.05 PIPE BEDDING GROOVES FOR NON-PERFORATED DRAIN LINES

A. Semicircular, trapezoidal, or 90-degree-V.

B. Excavated or plowed into trench bottom. Forming groove by compaction is not acceptable.

3.06 TEST PITS

A. For the purpose of locating underground obstructions, the Contractor shall make such excavations in advance of the Work, as directed.

3.07 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. In no case will bracing be permitted against pipes or structures in trenches or other excavations.

C. The Contractor shall be solely responsible for the safety and adequacy of all sheeting and bracing.

D. Sheeting and shoring to be removed:
   1. Design sheeting and shoring to be removed at completion of excavation work.
   2. In general, all sheeting and bracing, whether of steel, timber or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled.
   3. That portion of the sheeting extending below the top of a pipe or sewer shall be withdrawn, unless directed, before more than six (6) inches of earth is placed above the top of the pipe or sewer and before any bracing is removed.
   4. The voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose, or otherwise as may be approved.
   5. The Engineer may order the Contractor to delay the removal of sheeting and bracing, if in his judgement the installed work has not attained the necessary strength to permit placing of backfill.

E. Repair damage caused by failure of sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

F. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.08 PIPE BEDDING

A. Install to full width of trench, as detailed on the drawings.

B. Compact to at least 95 percent of its maximum density as determined by ASTM D1557.

C. Ensure that no unfilled or uncompacted areas occur beneath pipe.

D. Bell (Joint) holes: At each joint, dig bell holes of ample dimensions in bottom of trench, and at sides where necessary, to permit joint to be made properly and to permit easy visual inspection of entire joint.

E. Protect all utilities from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material.

F. Concrete cradles and pipe encasement:
   1. Install concrete cradles and encasement where shown on the drawings or ordered by the Engineer.
   2. Brace pipe in all directions to prevent flotation prior to concrete placement.

3.09 BACKFILLING

A. General:
   1. Backfill trenches to contours and elevations with unfrozen fill materials.
   2. Install metallic tape.
   3. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
   4. Pipe Bedding shall be used for backfilling below subgrade in trenches for pipelines or excavations for structures, provided the sides and bottoms of the excavations will remain stable when wet.
   5. Maintain optimum moisture content of fill materials to attain required compaction density.
   6. When for any reason the work is left unfinished, all trenches and excavations shall be filled and all roadways and sidewalks left unobstructed with their surfaces in a safe and satisfactory condition.
   7. Protect and cover open trench to prevent danger to the public with H20 load rated road plates.

B. Haunching:
   1. Place in 6-inch lifts compacted to at least 95 percent of its maximum density, as determined by ASTM D1557.
   2. Place such that even distribution is maintained on each side of the pipe at all times.

C. Initial Backfill:
   1. Place in 6-inch lifts compacted to at least 95 percent of its maximum density, as determined by ASTM D1557 unless otherwise specified.
   2. Place such that even distribution is maintained on each side of the pipe at all times.

D. Final Backfill shall be in accordance with Section 31 23 43 Excavating Backfilling and Compacting.

3.10 DRAINAGE

A. All material deposited in roadway ditches or other water courses crossed by the line of trench or near a structure shall be removed immediately after backfilling is completed and the section grades and contours of such ditches or water course restored to their original condition, in order that surface drainage will be obstructed no longer than necessary.

B. Backfilling of trenches for pipes installed beneath or across roadways, driveways, walks and other traffic ways adjacent to drainage ditches and water courses shall not be done prior to the completion of backfilling to the original ground surface of the trench on the upstream side of such traffic-way in order to prevent the impounding of water at any point after the pipe has been laid, and all necessary bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained.

C. All backfilling shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches.

D. When trenches are constructed in or across roadway ditches or other water courses, the backfill shall be protected from surface erosion by adequate and environmentally sound means.

3.11 RESTORATION OF SURFACES

A. The various types of street surface, gutters and culverts, disturbed, damaged or destroyed during the performance of the work under the Contractor, shall be restored and maintained as specified herein and as shown and directed.

B. Restoration of property:
   1. The Contractor shall restore all pavement, driveways, sidewalks, gutters, culverts, trees, shrubs, lawns, landscaped areas and any other public or private property damaged as a result of work under this Contract.
   2. The quality of materials and workmanship used in the restoration shall produce a condition equal to or better than the condition before the work began.

C. Time of replacement:
   1. In general, permanent restoration of street surfaces will not be permitted until one month’s time has elapsed after trenches have been completely backfilled as specified.
   2. A greater length of time, but not more than nine (9) months, may be allowed to elapse before permanent restoration of street surfaces is undertaken, if, in the opinion of the Engineer such additional time is required for complete shrinkage and settlement of the backfill.
   3. If the Contractor is permitted to replace pavement at any time by the Engineer, it shall not relieve the Contractor of responsibility to make repairs to damage caused by settlement for a period of one (1) year, or as elsewhere specified.

D. Schedule of operation: Develop a schedule of replacement operations and submit for approval.

E. Temporary resurfacing and repaving:
   1. Immediately upon completion of refilling of the trench or excavation, the Contractor shall place a temporary pavement over all disturbed areas of the streets, driveways, alleys and other traveled places where the original surface has been disturbed by his operations.
   2. The temporary re-pavement shall be of a character satisfactory in all respects and safe for public travel.
   3. The temporary resurfacing shall consist of a minimum of six inches (6") of well-graded broken stone with such additional depth as is necessary to withstand the traffic to which it is subjected.
   4. Where concrete pavements are removed, the broken stone shall be surfaced with "cold patch".
   5. The surface of the temporary repaving shall conform to the street grades.
   6. Mounding up of the material over the trench and covering the same with loose broken stone will not be considered as compliance with the above requirements.

F. Dust control: treat all surfaces, not covered with cold patch, as approved by the Engineer. Use of calcium chloride and/or petroleum products for dust control is prohibited.

G. Maintenance:
   1. Maintain temporary re-pavement in a safe and satisfactory condition until permanent repaving is complete.
   2. The Contractor shall immediately remove and restore to a satisfactory condition any and all such resurfacing and re-pavements as shall become unsatisfactory and not in accordance with the terms and intent of the Specifications.

H. Preparation for Permanent Replacement:
   1. After due notice and within the time specified, the temporary broken stone or gravel pavement shall be prepared as the base to receive the permanent pavement in accordance with Section 32 11 23, Aggregates for Earthwork.
   2. It shall be brought to the required grade and cross section and thoroughly compacted before placing the permanent pavement.
   3. Service boxes, manhole frames and covers, and similar structures, within the area of pavement to be replaced and not conforming to the new work, shall be set to established grade by the Contractor.

3.12 FIELD QUALITY CONTROL

A. Perform in place compaction tests in accordance with the following:
   1. Density Tests: ASTM D1557.
   2. Moisture Tests: ASTM D3017.

B. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

C. Frequency of tests: Each lift every 100 linear feet of trench.

D. The following reports in quadruplicate shall be submitted directly to the Engineer:
   1. Report and Certification of Gradation.
   2. Field Density Reports.
   3. One optimum moisture-maximum density curve for each type of fill.

3.13 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.14 TRENCH BACKFILL SCHEDULE

A. Pipe and Buried Utility Foundations: Structural Fill
   1. Pipe Bedding:
      a. Granular Fill: All piping unless otherwise specified, extending 6-inches below the outside diameter of the pipe barrel
      b. Sand: Copper, PVC, and HDPE, extending 6-inches below the outside diameter of the pipe barrel
   2. Haunching:
      a. Granular Fill: All piping unless otherwise specified
      b. Sand: Copper, PVC, and HDPE
   3. Initial Backfill:
      a. Granular Fill: All piping unless otherwise specified
      b. Sand: Copper, PVC, and HDPE
   4. Final Backfill:
      a. Select Subsoil or borrow material.

END OF SECTION

SECTION 31 23 43

EXCAVATING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Excavating, Backfilling and Compacting, as shown on the Plans, specified, and/or directed.

B. Excavation, in open cut, includes the loosening, removing, transporting, storage and disposal of all materials necessary to be removed for the construction and completion of all work under the Contract. Excavations shall be made to the widths and depths shown on the Plans, specified or directed.

C. The Contractor shall be responsible for maintaining the stability of any excavations and for any damage or injury to any person's property or structures as a result.

D. Where rock is encountered, the excavations shall be done in accordance with the applicable provisions hereof.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American Society for Testing and Materials (ASTM) Publications. Reference to standard Specifications is intended to specify minimum standards for quality of materials and performance of workmanship, and for standard test methods.

1.03 DEFINITIONS

A. The term "excavation" and the term "trenching" where used, shall be deemed and understood to cover the following described work, and the price bid for any and all items including "excavation", or "trenching" shall be deemed to include and cover all of the several following detailed operations:
   1. The loosening, removing, transporting, storage and rehandling of all materials;
   2. All sheeting, sheetpiling, bracing and shoring, and the placing, driving, cutting off and removing of the same;
   3. All ditching, pumping, bailing, dewatering and draining or otherwise disposing of water (surface and subsurface);

4. The refilling of trenches, excavations and pits, and the furnishing and placing of material over trenches, excavations and pits to the original surface of the ground or to other grades as may be shown or directed;
5. The compacting of all materials used in filling or refilling by rolling, ramming, watering, puddling, etc., as may be required;
6. The removing and disposing of all surplus materials from all excavations in the manner specified;
7. The maintenance, accommodation and protection of travel;
8. All temporary bridging and fencing/barricades and the removing of same, the temporary paving of roads, driveways.
9. The removing and clearing away of all construction rubbish, refuse, unused materials, plant and tools from the site;
10. The dressing, topsoiling, sodding and/or seeding of all unpaved areas disturbed by the Contractor within and outside the limits of the Contract as may be necessary to leave the surface in as good condition as it was previous to the commencement of the work.

B. "Earth" includes all materials, such as sand, gravel, clay loam, pavements, ashes, cinders, muck, roots, or pieces of timber, soft or disintegrated rock, not requiring barring or wedging from their original beds, and specifically excludes all ledge or bed rock, and individual boulders or masonry larger than one-half cubic yard in volume.

C. "Backfill" includes selected materials for the backfilling or refilling of all excavations and trenches up to the original surface of the ground or to other grades as may be shown or directed.

D. "Lining" includes selected materials utilized for the embedment of underground piping for the purpose of structural support and/or protection of the piping installed.

E. "Spoil" includes surplus excavated materials not required or not suitable for backfills or embankments.

F. "Embankments" include fills constructed of selected materials above the original surface of the ground.

G. "Rock" includes ledge or bedrock requiring barring or wedging from their original beds and individual boulders or masonry larger than one-half cubic yard in volume.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Where used for general site fill or suitable backfill, soil material shall be free of debris, roots, wood, scrap material, vegetative matter, refuse, soft unsound particles, frozen, deleterious, or objectionable materials.

2.02 CONTROLLED FILL

A. Controlled fill material shall be granular fill as specified in Section 31 05 16.

2.03 LINING:

A. Lining material where specified, for the embedment of PVC, cast iron, ductile iron shall be granular fill as specified in Section 31 05 16

PART 3 - EXECUTION

3.01 ROCK EXCAVATION

A. Rock excavation shall include the loosening, removing, transporting, storing and disposal of all materials requiring barring or wedging for removal from their original beds. Blasting will not be permitted. All pieces of ledge or bed rock and boulders or masonry larger than one-half (1/2) cubic yard in volume are included under rock excavation.

B. Rock excavations shall be made to the widths and depths shown on the Plans or as directed by the Engineer. For concrete structures, rock shall be excavated only to the bottom of the structure unless otherwise shown or noted on drawings. All excavated rock which cannot be handled and compacted as earth shall not be mixed with other backfill or embankment materials except as specified herein or as directed.

3.02 EXCAVATION FOR STRUCTURES

A. Excavation shall be of sufficient size, and only of sufficient size, to give suitable room for the proper construction of structures and appurtenances, including allowances for sheeting, dewatering, and other similar work necessary for completion of the Contract.

B. Excavations for structures shall be made only to the lines and grades shown on the Plans, specified or directed.

C. In no case will under cutting excavation faces for extended footings be permitted. Not less than twelve (12) inches clearance shall be provided between excavation faces and brick or block masonry exterior wall surfaces which are to be waterproofed.

D. Subgrade for all footings and foundations shall be undisturbed original earth, thoroughly compacted where noted on drawings. Keep all excavations free from water. Excavate soil disturbed or weakened by Contractor's operations and soils softened or made unsuitable for subsequent construction due to exposure to weather.

1. Where excavation below subgrade is ordered, it shall be thoroughly compacted and consolidated granular fill as directed and as specified in Section 31 05 16. It shall be sufficiently stable to remain firm and intact during the surfacing of subgrade, laying reinforcing steel and placing concrete thereon.
2. Where necessary, a layer of Class "D" concrete of sufficient strength and thickness to withstand subsequent construction operations shall be installed below the specified subgrade elevation and the structural concrete deposited thereon. The finished elevation of any subsoil reinforced in this manner shall not be above the specified subgrade.

E. The bottom of the excavation for foundation wall footing in undisturbed soil shall be tested for bearing capacity by a Contractor hired testing laboratory using a standard soil penetrometer test or equal. Results of tests shall be submitted directly to the Engineer.

3.03 BACKFILLING AROUND STRUCTURES

A. Backfilling around structures shall not be commenced until all lumber, refuse, rubbish and other similar materials are removed from the excavated area. Backfill around structures may be placed by machine, provided the work shall be done carefully to prevent damage to the structure. In no case shall backfill materials be allowed to fall directly on a structure, until at least twelve (12) inches of hand-placed material has been placed thereon and compacted.

B. Backfill around structures shall be deposited in horizontal layers not more than eight (8) inches in thickness and shall be thoroughly compacted. Compaction shall be by a vibrating tamper or other approved method and shall be to a minimum dry density of ninety-five (95) percent of the maximum dry weight density in pounds per cubic foot as determined by the Modified Proctor Compaction Test (ASTM D1557). Compact adjacent areas, beyond five (5) feet of a slab or structure, to ninety (90) percent of ASTM D1557.

C. Backfilling shall be done immediately after work has been inspected and approved. No frozen material shall be used, nor shall backfilling be placed on or against frozen earth, debris or other deleterious matter not conducive to proper compaction.

D. Backfilling against free standing walls shall be made against both sides at the same time. If backfill is required on one side only, the wall shall be adequately braced on the opposite side until properly cured to full strength.

E. Contractor shall take every necessary precaution during compaction of fill adjacent to foundations, walls, etc., that such items are not displaced from their proper location or damaged by compacting equipment. In the event damage or displacement occurs during or resulting from compaction of fill as specified above, the Contractor shall be responsible for correcting the same, to approval of the Engineer and at no expense to the Owner.

F. Controlled fill within building lines, under concrete slabs and aprons shall be granular fill as specified in Section 31 05 16, "Aggregates For Earthwork". Areas of completed fill which are to receive slabs, pavements and structures, etc., shall be kept free of standing water or otherwise protected from any loss of compaction density.

3.04 TRENCHING

A. The alignment, depth and pipe subgrades of all pipe trenches shall be determined by overhead grade lines parallel to the pipe invert, electrical laser beam or other grade control devices, installed and maintained by the Contractor.

B. Width and Depth of Trenches: The trenches in which pipelines are to be constructed, shall be excavated in all cases in such manner and to such depths and widths as will give suitable room for the pipelines which the trenches are to contain, for stability, sheeting, pumping, dewatering, and draining of water, and for removing the material not suitable for pipe subgrade.

C. Unless otherwise specified, trenches for pipes shall be not less than six (6) inches wider and deeper than the hubs of the pipe on each side and below, when measured from the hubs of the pipe.

3.05 EARTH SUBGRADE PREPARATION FOR PIPES

A. Unless otherwise permitted by the Engineer, the trench shall have a flat bottom conforming to the grade to which the pipe is to be laid.

B. Except where concrete cradle or encasement is required below the specified pipe subgrade, mechanical excavation of trenches for pipe shall not extend lower than one (1) inch above the finished pipe subgrade elevation at any point. The remainder of the trench excavation shall be made with hand tools.

C. Pipe subgrade preparation shall be performed immediately prior to installing the pipe in the trench. The trench bottom shall be accurately graded by means of hand tools in such a manner that a uniform and continuous bearing and support on solid and undisturbed ground is provided for each pipe for its entire length or between bell holes.

D. All trenches shall be so graded that the spigot end of the pipe will be accurately centered in the adjacent pipe bell when laid, without raising the pipe off the trench bottom. Regrading of a trench bottom which is too high will be permitted. Correction of a subgrade that is too low shall be done only by placing and compacting granular fill over the entire width of the trench and regrading.

3.06 EXCAVATION FOR CONCRETE CRADLE OR ENCASEMENT

A. Where concrete cradle or encasement is required, the trench subgrade elevation will be determined by the required concrete section in each case. Unless otherwise authorized by the Engineer, concrete cradle or encasement shall extend across the full width of the trench as excavated, and the concrete therein shall be poured directly against vertical trench banks. In the case of concrete cradle or encasement of pipe in a sheeted trench, the concrete may be poured directly against sheeting which is to be left in place in the trench, as specified.

3.07 PIPE LINING:

A. All pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable specified pipe lining material. Except where loading or subsoil conditions require the use of concrete cradle or encasement, all pipe lining shall be placed so as to insure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment operations. The amount of suitable specified pipe lining material to hold the pipe in rigid alignment shall extend not less than 6 inches in any direction from the hub of the pipe and shall be uniformly deposited and thoroughly compacted on each side, and back of the bell, of each pipe laid.

B. Pipe lining materials placed at any point below an elevation six (6) inches above the top of pipe or sewer, shall be deposited and compacted in layers not to exceed four (4) inches in uncompacted depth, and such deposition and compactions shall be done simultaneously and uniformly on both sides of the pipe. Compaction shall be by vibrating tamper or other approved method and shall be to a minimum dry density of ninety-five (95) percent of the maximum dry weight density in pounds per cubic foot as determined by the Modified Proctor Compaction Test. All such materials shall be placed in the trench with hand tools in such a manner that they will be scattered alongside the pipe and not dropped into the trench in compact masses.

C. Concrete cradle and encasement of the class specified shall be installed where and as shown on the Plans or ordered by the Engineer. Before concrete cradle or encasement is placed, the pipe shall be braced in all directions to prevent movement or flotation.

3.08 BACKFILL ABOVE PIPE LINING:

A. The portion of pipe trenches between the top of the pipe lining and the upper limit of backfill shall be refilled with suitable materials as shown or indicated on drawings, or as specified herein.

B. Where trenches are within structures or the ditch-to-ditch or edge of pavement limits of any road, driveway or other recognized traveled vehicular way, or within other limits that may be specifically shown or specified for this purpose, the backfill materials shall be deposited in the trench in horizontal layers not more than eight (8) inches in thickness, and each layer shall be compacted by vibrating tamper or other approved method and shall be to a minimum dry density of ninety-five (95) percent of the maximum dry weight density in pounds per cubic foot as determined by the Modified Proctor Compaction Test (ASTM D1557).

C. Where trenches are outside structures or the ditch-to-ditch or edge of pavement limits of any road, driveway or other recognized traveled vehicular way, and outside of other limits that may be specifically shown or specified as areas in which mechanical compaction in layers is to be performed, the backfill material may be deposited in the trench by mechanical means for the full depth of the trench between the top of pipe embedment and ground surface with no special compaction. In such case the backfill materials shall be mounded over the trench to an elevation slightly above desired finished grade to allow for settlement and compaction by natural means, and the Contractor shall return to the area during his clean-up operations to remove any excess materials remaining above finished grade or add sufficient additional backfill to bring the completed work to grade. If a hazard should be created by such excess materials, or by settlement below finished grade, prior to the performance of clean-up operations, the Contractor shall remove such excess, or add additional backfill, at the time the hazard is created or when directed.

D. Any additional material added during clean-up operations, or at any other time to prevent or remove a hazard, shall be placed in horizontal layers not more than eight (8) inches in thickness, with each layer adequately compacted by mechanical means, by the Contractor at his own expense.

3.09 REMOVAL OF WATER

A. The Contractor shall at all times during construction provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work or the proper placing of pipe, masonry, concrete, structures, or other work.

B. Removal of water includes the construction and removal of sheeting and bracing, the furnishing of materials, equipment and labor necessary therefore, the excavation and maintenance of ditches and sluice-ways and the furnishing and operation of pumps, and appliances needed to maintain thorough drainage of the work in a satisfactory manner.

C. Water shall not be allowed to rise over or come in contact with any masonry, concrete or mortar, until at least twenty-four (24) hours after placement, and no stream of water shall be allowed to flow over such work until such time as the Engineer may permit.

D. Unless otherwise specified, all excavations which extend down to below the groundwater elevation at the sites of structures shall be dewatered by lowering and maintaining the groundwater beneath such excavations at an elevation not less than that specified herein at all times when work thereon is in progress, during subgrade preparation and the placing of the structures or pipe thereon.

E. Where an upward pressure or flow of water in combination with a fine-grained subsurface material causes a quick condition, the Contractor shall install wellpoints to stabilize the subgrade. Where wellpoints are used, the groundwater table shall be continuously (day and night) maintained to an elevation of not less than twenty-four (24) inches below the excavation and when subgrade is reached the groundwater shall be maintained not less than twenty-four (24) inches below the subgrade. Unless otherwise permitted by the Engineer, the groundwater shall be maintained not less than twenty-four (24) inches below the subgrade until completion of the backfilling to an elevation at least twelve (12) inches above natural groundwater level. Wellpoint headers, points, and other pertinent equipment shall not be placed within the limits of the excavation in such a manner or location as to interfere with the laying of pipe or trenching operations or with the excavation for and construction of other structures.

F. In areas where groundwater enters the excavation but does not cause a quick condition, the groundwater may be removed by any practical method which does not damage the subgrade, cause the same to become unstable or interferes with construction operations.

G. The groundwater control requirements specified for wellpointing operations apply to other dewatering methods.

H. Suitable stand-by pumping equipment shall be provided to insure the maintenance of the specified lowering of the water table.

I. Water pumped or drained from excavations, or any sewers, drains, or water courses encountered in the work, shall be disposed of in a suitable and environmental manner without injury to adjacent property, the work under construction, or to pavements, roads, and drives. No water shall be discharged to sanitary sewers. Sanitary sewage shall be pumped to sanitary sewers or shall be disposed of by an approved method.

J. Any damage caused by improper handling of water shall be repaired by the Contractor at his own expense.

3.10 SHEETING & BRACING

A. The Contractor shall furnish, place and maintain such sheeting, bracing and shoring as may be required to support the sides and ends of excavations in such manner as to prevent any movement which could, in any way, injure the pipe, sewers, masonry, or other work; diminish the width necessary; otherwise damage or delay the work; or endanger existing structures, pipes or pavements; cause the excavation limits to exceed the right-of-way limits; or to occasion a hazard to persons engaged on the project or to the general public.

B. In no case will bracing be permitted against pipes or structures in trenches or other excavations.

C. The Contractor shall be solely responsible for the safety and adequacy of all sheeting and bracing. He shall make good any damage resulting from failure of supports with no additional cost to Owner.

3.11 REMOVAL OF SHEETING & BRACING

A. In general, all sheeting and bracing, whether of steel, timber or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a pipe or sewer shall be withdrawn, unless directed, before more than six (6) inches of earth is placed above the top of the pipe or sewer and before any bracing is removed. The voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose, or otherwise as may be approved.

B. The Engineer may order the Contractor to delay the removal of sheeting and bracing, if in his judgement the installed work has not attained the necessary strength to permit placing of backfill.

C. Sheeting & Bracing Left In Place:

1. If, to serve any purpose of his own, the Contractor files a written request for permission to leave sheeting or bracing in the trench or excavation, the Engineer may grant such permission, in writing, on condition that the cost of such sheeting and bracing be assumed and paid by the Contractor.
2. The Contractor shall leave in place all sheeting, shoring and bracing which are shown on the Drawings or specified to be left in place or which the Engineer may order, in writing, to be left in place. All shoring, sheeting, and bracing shown or ordered to be left in place will be paid for under the appropriate item of the Contract. No payment allowance will be made for wasted ends or for portions above the proposed cut-off level which are driven down instead of cut-off.
3. In case sheeting is left in place, it shall be cut off or driven down as directed so that no portion of the same shall remain within twelve (12) inches of the finished street or ground surface.
4. All timber sheeting and bracing to be left in place and paid for under an item of the Contract shall be new, sound and straight, free from cracks, shakes and large or loose knots, and shall otherwise conform with National Design Specifications for Stress Grade Lumber for lumber of a minimum fiber stress of 1,200 pounds per square inch.
5. Steel sheeting and bracing left in place and paid for under an item of the Contract shall be new and shall conform with ASTM Des: A7, with a minimum thickness of 3/8-inch.
6. Sheeting and bracing left in place and paid for under an item of the Contract shall be driven as the excavation progresses and in such manner as to maintain pressure against the original ground at all times. The sheeting shall be driven vertical with the edges tight together, and all bracing shall be of such design and strength as to maintain the sheeting in its proper position.

3.12 STORAGE OF MATERIAL

A. Topsoil suitable for final grading shall be removed and stored on the Site separately from other excavated material, and shall be replaced in position upon completion of the work.

B. All excavation materials shall be stored in locations so as not to endanger the work, and so that easy access may be had at all times to all parts of the excavation. Stored materials shall be kept neatly piled and trimmed. All stockpiled fill material shall be stored only in those fill areas as approved by the Engineer and the New York State Department of Environmental Conservation.

3.13 ADDITIONAL EXCAVATION

A. In case the materials encountered at the locations and grades shown on the Plans or specified are not suitable, or in case it is found desirable or necessary to excavate additional materials to secure good support for the structure or pipeline, the excavation shall be carried to such additional limits as the Engineer may direct. The Contractor shall refill such additional excavated space with either granular fill, Class "D" or "E" concrete or other material, as the Engineer may direct. Additional excavation, backfill material, concrete or other materials so ordered, will be paid for under the appropriate items of the Contract.

3.14 UNAUTHORIZED EXCAVATION:

A. Whenever excavations are carried beyond or below the lines and grades shown on the Plans, or as given or directed by the Engineer, all such excavated space shall be refilled with granular fill, concrete or other materials as directed by the Engineer. All refilling of unauthorized excavations shall be at the Contractor's own expense.

B. All material which slides, falls or caves into the established limits of excavations due to any cause whatsoever shall be removed and disposed of at the Contractor's own expense, and no extra compensation will be paid the Contractor for any materials ordered for refilling the void areas left by the slide, fall or cave-in.

3.15 DISPOSAL OF MATERIALS

A. All spoil shall be transported and placed off site at the locations and to the elevations and grades shown on the Plans or as directed by the Engineer. If spoil areas are not shown, all spoil materials shall be disposed off the Site at the Village (Owner) dump site approximately one mile away. No environmental sensitive areas shall be used for spoil areas. A copy of the signed agreement between the Village and the Contractor granting permission to deposit spoil shall be given to the Engineer prior to placement.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Aggregates for Earthwork: Section 31 05 16.

B. Excavation Backfilling and Compacting: Section 31 23 43.

C. Topsoil Placement and Grading: Section 32 91 19.13.

D. Seeding: Section 32 92 19.

1.02 REFERENCES

A. Erosion and Sediment Control Guidelines: Conform to the latest edition of "NEW YORK STANDARDS and SPECIFICATIONS for EROSION and SEDIMENT CONTROL" by NYS Department of Environmental Conservation DOW (i.e., Bluebook). Refer to these guidelines for construction and maintenance of all items (Temporary and Permanent Structural, Vegetative and Biotechnical) included in the Storm Water Pollution and Prevention Plan (SWPPP).

B. Stormwater Management: Conform to the latest edition of "NEW YORK STATE STORMWATER MANAGEMENT DESIGN MANUAL" prepared by Center for Watershed Protection for NYS Department of Environmental Conservation.

1.03 RESPONSIBILITY

A. Provide any temporary sediment and erosion control measures that may be required within limits of the work, including any staging areas, throughout construction in conformance with the plan, and as directed by the Engineer. Place the permanent control practices required before the removal of the temporary storm water diversion and control items.

B. During construction conduct operations in such a manner as to prevent or reduce to a minimum any damage to any water body from pollution by debris, sediment, chemical or other foreign material, or from the manipulation of equipment and/or materials in or near a stream or ditch flowing directly to a stream. Any water which has been used for wash purposes or other similar operations which become polluted with sewage, silt, cement, concentrated chlorine, oil, fuels, lubricants, bitumens, or other impurities shall not be discharged into any water body.

C. In the event of conflict between these Specifications and the regulation of other Federal, State, or local jurisdictions, the more restrictive regulations shall apply.

1.04 DESCRIPTION

A. The work shall consist of furnishing, installing, inspecting, maintaining, and removing soil and erosion control measures as shown on the Contract Documents or as ordered by the Engineer during the life of the Contract to provide erosion and sediment control.

B. Temporary structural measures provide erosion control protection to a critical area for an interim period. A critical area is any disturbed, denuded slope subject to erosion. These are used during construction to prevent offsite sedimentation. Temporary structural measures shall include check dams, construction road stabilization, stabilized construction entrance, dust control, earth dike, level spreader, perimeter dike/swale, pipe slope drain, portable sediment tank, rock dam, sediment basin, sediment traps, silt fence, storm drain inlet protection, straw/hay bale dike, access waterway crossing, storm drain diversion, temporary swale, turbidity curtain, water bars or other erosion control devices or methods as required.

C. Permanent structural measures also control protection to a critical area. They are used to convey runoff to a safe outlet. They remain in place and continue to function after completion of construction. Permanent structural measures shall include debris basins, diversion, grade stabilization structure, land grading, lined waterway (rock), paved channel, paved flume, retaining wall, riprap, rock outlets, and stream bank protection or other erosion control devices or methods as required.

D. Vegetative measures shall include brush matting, dune stabilization, grassed waterway, vegetating waterway, mulching, protecting vegetation, seeding, sod, straw/hay bale dike, stream bank protection, temporary swale, topsoil, and vegetating waterways.

E. Biotechnical measures shall include wattling (live fascines, brush matting, brush layering, live cribwall, and branchpacking) vegetated rock gabions, live staking, tree revetment, and fiber rolls.

F. Weekly inspections will be completed by the Engineer (if required). Comply with and correct all deficiencies found as a result of these inspections. At the end of the construction season when soil disturbance activities will be finalized or suspended until the following spring, the frequency of the inspections may be reduced. If soil disturbance is completely suspended and the site is properly stabilized, a minimum of monthly inspections must be maintained. The stabilization activities must be completed before snow cover or frozen ground. If

vegetation is required, seeding, planting and/or sodding must be scheduled to avoid die-off from fall frosts and allow for proper germination/establishment. Weekly inspections must resume no later than March 15.

1.05 DEFINITIONS - TEMPORARY STRUCTURAL MEASURES

A. Check Dam: Small barrier or dam constructed of stone, bagged sand or gravel to reduce velocity of flow.

B. Construction Road Stabilization: Stabilization of construction roads to control erosion.

C. Stabilized Construction Entrance: A stabilized pad of aggregate underlain with geo-textile where traffic enters a construction site to reduce or eliminate tracking of sediment to public roads.

D. Dust Control: Prevent surface and air movement of dust from disturbed soil surfaces.

E. Earth Dike: A temporary berm or ridge of compacted soil, located to channel water to a sediment trapping device.

F. Level Spreader: A non-erosive outlet for concentrated runoff to disperse flow uniformly across a slope.

G. Perimeter Dike/Swale: A temporary ridge of soil excavated from an adjoining swale located along the perimeter of the site or disturbed area to prevent runoff from entering a disturbed area and preventing sediment laden runoff from leaving a construction site.

H. Pipe Slope Drain: A structure placed from the top of a slope to the bottom of a slope to convey runoff without causing erosion.

.I. Portable Sediment Tank: A compartmented tank to which sediment laden water is pumped to retain sediment before pumping the water to adjoining drainage ways.

J. Rock Dam: A rock embankment located to capture sediment.

K. Sediment Basin: A barrier constructed across a drainage way to intercept and trap sediment.

L. Sediment Traps: A control device formed by excavation to retain sediment at a storm inlet or other points of collection.

M. Silt Fence: A barrier of geo-textile fabric installed on contours across the slope to intercept runoff by reducing velocity. Replace after 1 year.

N. Storm Drain Inlet Protection: A semi-permeable barrier installed around storm inlets to prevent sediment from entering a storm drainage system.

O. Straw/Hay Bale Dike: Intercept sediment laden runoff by reducing velocity. Replace after 3 months.

P. Access Waterway Crossing: A structure placed across a waterway to provide circulation for construction purposes.

Q. Storm drain Diversion: The redirection of a storm drain line or outfall channel for discharge into a sediment trapping device.

R. Temporary Swale: A temporary excavated drainage swale.

S. Turbidity Curtain: A flexible, impenetrable barrier used to trap sediment when construction occurs within water bodies or along a shoreline.

T. Water Bars: A ridge or channel constructed diagonally across a sloping road or right-of-way.

U. Filter Bags: A dewatering bag that removes and filters sand, silt and fines out of water.

1.06 DEFINITIONS - PERMANENT STRUCTURAL MEASURES

A. Diversion: A parabolic or trapezoidal swale with a supporting ridge on the lower side constructed across a slope to intercept and convey runoff to stable outlets at non-erosive velocities.

B. Debris Basin: A barrier or dam constructed across a waterway to form a basin for catching and storing sediment or debris that gives protection downstream.

C. Grade Stabilization Structure: A structure to stabilize the grade by providing channel linings that can withstand high velocities.

D. Lined Waterway (rock): A waterway lined with stone to dispose of high velocity runoff.

E. Paved Channel (concrete): A waterway lined with concrete to dispose of high velocity runoff.

F. Paved Flume: A concrete lined channel to convey water down a steep slope.

G. Retaining Wall: A structural wall constructed to prevent soil movement down steep slopes.

H. Riprap: A layer of stone designed to protect slopes that are subject to erosion.

I. Rock Outlets: Rock placed at the outlet end of culverts, conduits or channels.

J. Rock Outlets: Rock placed at the outlet end of culverts, conduits or channels.

K. Stream Bank Protection: Stabilization of eroding stream banks through use of riprap, gabions or pre-cast concrete units.

1.07 DEFINITIONS - VEGETATIVE MATERIALS MEASURES

A. Brush Matting: Hardwood brush layered along a stream bank with a grid of stakes and wire. This acts as a mulch for seedlings established in the bank.

B. Dune Stabilization:

C. Grassed or Vegetating Waterway: A parabolic or trapezoidal channel below adjacent ground level stabilized by vegetation to convey water without causing erosion.

D. Mulches: Hay, straw, wood cellulose, fiber mats, flexible growth medium and other materials approved by the Engineer.

E. Protecting Vegetation: Protecting trees, shrubs, ground cover and other vegetation from damage.

F. Temporary Seeding: Erosion control protection to a critical area for an interim period. A critical area is any disturbed, denuded slope subject to erosion.

G. Permanent Seeding: Grasses established and combined with shrubs to provide perennial vegetative cover on disturbed, denuded, slopes subject to erosion.

H. Sod: Used where a quick vegetative cover is required.

I. Straw/Hay Bale Dike: Intercept sediment laden runoff by reducing velocity. Replace after 3 months.

J. Stream Bank Protection: Stabilization of eroding stream banks through use of vegetation.

K. Temporary Swale: A temporary excavated drainage swale.

L. Topsoil: Placed before permanent seeding or sod is installed.

1.08 DEFINITIONS - BIOTECHNICAL MATERIALS MEASURES

A. Vegetative Rock Gabions: A combination of vegetation and rock gabions for slope stabilization. Live branch cuttings are layered through the gabion protruding beyond the face of the gabion.

B. Live Fascines: Bundles of branches staked into shallow trenches which are then filled with soil. They are oriented along a contour and placed in multiple rows.

C. Brush Matting: Hardwood brush layered along a stream bank with a grid of stakes and wire. This acts as a mulch for seedlings established in the bank.

D. Live Staking: Large stakes sharpened at the bottom end and forced vertically into the ground.

E. Brush Layering: Stabilize slope areas above the flow line of stream banks. Long branches are placed with cut ends into a terraced slope.

F. Live Crib Wall: A combination of vegetation and structural elements used along streams where flowing water is a hazard. Layers of logs are alternated with long branches protruding out between them.

G. Tree Revetment: Used for bank stabilization by placing tree trunks and branches overlapped and anchored to absorb energy, reduce velocity and capture sediment.

H. Branch Packing: Alternates live branch cuttings and tamped backfill to repair small localized holes in slopes. Used for areas less than 4' deep and 6' wide.

I. Fiber Roll: A coconut fiber, straw, or excelsior woven roll encased in a netting of jute, nylon, or burlap to dissipate water energy and provide a medium for introduction of herbaceous vegetation. Anchor into a bank and provide suitable backfill behind the roll where vegetation can be planted.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Plant Materials for biotechnical slope protection (if required): Locate stands of specified species and obtain approval to harvest material from these stands or obtain from managed production beds that are maintained for commercial distribution. Install all plant materials within 8 hours of cutting or provide proper storage.
   1. Shrub willows: "Streamco" purpleosier willow, and "Bankers" dwarf willow.
   2. Redosier Dogwood

B. Seeding: Permanent see Section 32 92 19.

2.02 COMPANIES-TEMPORARY STRUCTURAL

A. Mirafi, 365 South Holland Drive, Pendergrass, Ga, 30567, (888) 795-0808, www.mirafi.com.

B. North American Green, 14649 Highway 41 North, Evansville, IN 47725, (800) 772-2040, www.nagreen.com.

C. Siltdam, Inc., P.O. Box 960, Brockton MA, 02303, (800) 699-2374, www. spilldam. com.

D. Nedia Enterprises, Inc., 22187 Vantage Pointe Place, Ashburn, VA 20148, (888) 725-6999, www.nedia.com.

E. Belton Industries, 5600 Oakbrook Parkway, Norcross GA, 30093, (800) 225-4099, www.beltonindustries.com.

F. KriStar, 1219 Briggs Ave., Santa Rosa, CA 95401, (800) 579-8819, www.kristar.com.

G. Rolanka International, Inc., 155 Andrew Drive, Stockbridge, GA 30281, (800) 760-3215, www.rolanka.com.

H. Apex Resources Inc., 12910 Shelbyville Road, Louisville, KY 40243 (888) 677-2739, www.apexr.com.

I. MonoSol, LLC, 707 E. 80th PL., Merrillville, IN 46410 (800) 237-9552, www.terraloc.com.

J. Brockton Equipment Inc., P.O. Box 960, Brockton, MA 02303 (800) 699-2374, www. spilldam. com.

K. Aer-Flo Inc., 4455 18th St. East, Bradenton, FL 34203 (800) 823-7356, www. aerflo. com.

L. Contech Construction Products Inc., 9025 Centre Point Drive, Suite 400, West Chester, Ohio 45069, (800) 338-1122, www.contech-cpi.com.

2.03 COMPANIES-PERMANENT STRUCTURAL

A. Contech Construction Products Inc., 9025 Centre Point Drive, Suite 400, West Chester, Ohio 45069, (800) 338-1122, www.contech-cpi.com.

2.04 COMPANIES-VEGETATIVE

A. Nedia Enterprises, Inc., 22187 Vantage Pointe Place, Ashburn, VA 20148, (888) 725-6999, www.nedia.com.

B. Agrecol Corporation, 2918 Agriculture Drive, Madison, Wi, 53718, (608) 226-2544, www.agrecol.com.

2.05 COMPANIES-BIOTECHNICAL

A. Rolanka International Inc., 155 Andrew Drive, Stockbridge GA 30281, (800) 760-3215, www.rolanka.com.

B. Nedia Enterprises, Inc., www.nedia.com.

C. Kristar (800) 579-8819.

PART 3 - EXECUTION

3.01 WORK AREAS

A. The Engineer has the authority to limit the surface area of erodible earth exposed by earthwork operations and to direct the Contractor to provide immediate temporary or permanent erosion measures to minimize damage to property and contamination of watercourses and water impoundments. Under no circumstances will the area of erodible earth material exposed at one time exceed 50,000 sq. ft. The Engineer may increase or decrease this area of erodible earth material exposed at one time as determined by his analysis of project, weather and other conditions. The Engineer may limit the area of clearing and grubbing and earthwork operations in progress commensurate with the Contractor's demonstrated capability in protecting erodible earth surfaces with temporary, permanent, vegetative or biotechnical erosion control measures.

B. Schedule the work so as to minimize the time that earth areas will be exposed to erosive conditions. Provide temporary structural measures immediately to prevent any soil erosion.

C. Provide temporary seeding on disturbed earth or soil stockpiles exposed for more than 7 days or for any temporary shutdown of construction. In spring, summer or early fall apply rye grass at a rate of 1 lb/ 1000 sq. ft. In late fall or early spring, apply certified Aroostook Rye at a rate of 2.5 lbs./ 1000 sq. ft. Apply hay or straw at a rate of 2 bales/1000 sq. ft. or wood fiber hydromulch at the manufacturer's recommended rate. Hay or straw shall be anchored.

D. Coordinate the use of permanent controls or finish materials shown with the temporary erosion measures.

E. All erosion and sediment control devices must be maintained in working order until the site is stabilized. All preventative and remedial maintenance work, including clean out, repair, replacement, regrading, reseeding, or re-mulching, must be performed immediately.

F. After final stabilization has been achieved temporary sediment and erosion controls must be removed. Areas disturbed during removal must be stabilized immediately.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes all material and performance requirements for asphalt paving materials as called on the Plans, including:
   1. Asphalt paving base course.
   2. Binder course.
   3. Top course.
   4. Tack coats.

B. See Section 31 05 16, Aggregate For Earthwork for aggregate base course requirements.

1.02 REFERENCE STANDARDS

A. The following is a list of standards which may be referenced in this Section:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M17, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
      b. M81, Standard Specification for Cut-Back Asphalt (Rapid Curing Type).
      c. M82, Standard Specification for Cut-Back Asphalt (Medium Curing Type).
      d. M140, Standard Specification for Emulsified Asphalt.
      e. M208, Standard Specification for Cationic Emulsified Asphalt.
      f. T166, Standard Method of Test for Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens.
      g. T176, Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test.
      h. T230, Standard Method of Test for Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures.
      i. T245, Standard Method of Test for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus.
      j. T246, Standard Method of Test for Resistance of Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus.
      k. T247, Standard Method of Test for Preparation of Test Specimens of Bituminous Mixtures by Means of California Kneading Compactor.
      l. T283, Standard Method of Test for Resistance of Compacted Bituminous Mixture to Moisture-Induced Damage.

m. T304, Standard Method of Test for Uncompacted Void Content of Fine Aggregate (Method A).

2. Asphalt Institute (AI):
   a. Manual Series No. 2 (SP-2), Mix Design Methods for Asphalt Concrete.
   b. Superpave Series No. 2 (SP-2), Superpave Mix Design.
3. ASTM International (ASTM):
   a. D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   b. D4791, Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
   c. D5281, Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.
   d. E329, Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
4. State of New York Department of Transportation, Standard Specifications.

1.03 DEFINITIONS

A. Combined aggregate: All mineral constituents of asphalt concrete mix, including mineral filler and separately sized aggregates.

B. RAP: Reclaimed asphalt pavement.

C. Standard Specifications: State of New York Department of Transportation (NYSDOT) Standard Specifications.

1.04 DESIGN REQUIREMENTS

A. Prepare asphalt mix design in accordance the Standard Specifications.

B. All thicknesses of pavement courses described herein or shown on the Drawings represent compacted thicknesses.

1.05 SUBMITTALS

A. Informational submittals:
   1. Test report for asphalt concrete:
      a. Submit a minimum 10 days prior to start of production.
      b. Show appropriate test method(s) for each material and the test results.
   2. Manufacturer's Certificate of Compliance for the following materials:
      a. Aggregate: gradation, source test results as defined in Section 703 of the NYSDOT Standard Specifications.
      b. Asphalt for binder: Type, grade, and viscosity-temperature curve.
      c. Tack coat: Type and grade of asphalt.
      d. Additives.
      e. Mix: Conforms to job-mix formula.

3. Statement of qualification for independent testing laboratory.
4. Test results:
    a. Mix design.
    b. Asphalt concrete core.
    c. Gradation and asphalt content of uncompacted mix.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with the Standard Specifications as amended and/or supplement herein.

B. Qualifications:
1. Independent Testing Laboratory: In accordance with ASTM E329.
2. Asphalt concrete mix formula shall be prepared by approved, certified independent laboratory under the supervision of a certified asphalt technician.

C. Compaction control strip:
1. General:
    a. Construct to approximately 4,300 square feet in area and at a location that will become a portion of the completed paved area.
    b. Thickness: Typical thickness to be paved on the Project.
2. Rollers used for compaction:
    a. Steel wheel rollers: Minimum static weight of 10 tons.
    b. Pneumatic rollers: Capable of exerting pressure of 80 psi on bituminous surface.
    c. Vibratory rollers: Minimum static weight of 6 tons, capable of applying a 10-ton impact force equipped with amplitude and frequency control specifically designed for compaction of bituminous mixtures.
3. Compaction:
    a. Compact bituminous mat using standard rolling patter that covers the entire control strip. Request that the Engineer performs a final density test.
    b. Continue rolling until no further compaction can be obtained as determined by field density testing.
    c. Temperature and condition of bituminous mat shall be considered workable when further compaction can no longer be obtained.
4. Target density determination:
    a. Select test point near center of normal roller pass, but no closer than 2 feet from the edge of mat and 50 feet from each end of the control strip. Mat thickness at this point shall be at least the depth of the finished pavement.
    b. This shall be the point at which no further densification can be obtained.

5. Establish a new target density if changes are made in the mix design, nominal depth of mat being placed, aggregate source, or material properties.

1.07 AMBIENT CONDITIONS

A. Weather and seasonal limitations shall comply with the Standard Specifications. NYSDOT Standard Specifications Section 402-3.01.

PART 2 - PRODUCTS

2.01 MATERIALS – NEW YORK STATE

A. Mixtures: designed in accordance with NYSDOT standards:
   1. Top Course: 9.5 mm Superpave F2 Top Course HMA.
   2. Binder Course: 19.0 mm F9 Binder Course HMA.
   3. Base Course: 37.5 mm F9 Base Course HMA.
   4. Subbase Course: Item 304.12, Subbase Course, Type 2

B. Tack coat:
   1. Shall be applied between all lifts of HMA courses and where new asphalt meets existing asphalt or concrete.
   2. Comply with the requirements of NYSDOT Section 702 Bituminous Materials

2.02 ASPHALT CONCRETE MIX – NEW YORK STATE

A. General:
   1. Mix formula shall not be modified except with written approval of the Engineer.
   2. Source changes:
      a. Should material source(s) change, establish new asphalt concrete mix formula before new material(s) is used.
      b. Perform check tests of properties of plant-mix bituminous materials on first day of production and as requested by the Engineer to confirm that properties are in compliance with design criteria.
      c. Make adjustments in gradation or asphalt content as necessary to meet design criteria.

B. Asphalt concrete: As specified in Section 403 of the Standard Specifications.

C. Composition:
   1. Hot-mix asphalt plant of aggregate, mineral filler if required, and paving grade asphalt cement.

2. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that resulting mixture meets grading requirements of the mix.

D. Aggregate:
   1. General: as specified in Section 703 of the Standard Specifications.
   2. RAP will not be acceptable.

E. Mineral filler: in accordance with Section 703-08 of the Standard Specifications.

F. Asphalt cement: Paving grades 18-60, as specified in Section 702 of the Standard Specifications.

PART 3 - EXECUTION

3.01 GENERAL

A. Traffic control:
   1. Minimize inconvenience to traffic, but keep vehicles off freshly-treated or paved surfaces to avoid pickup and tracking of asphalt.

B. Driveways: Repave driveways from which pavement was removed. Leave driveways in as good or better condition than before start of construction.

3.02 LINE AND GRADE

A. Provide and maintain intermediate control of line and grade, independent of underlying base, to meet finish surface grades and minimum thickness.

B. Shoulders: Construct to line, grade, and cross-section shown.

3.03 APPLICATION EQUIPMENT

A. In accordance with the Standard Specifications.

3.04 PREPARATION

A. Prepare subgrade and subbase in accordance with the Standard Specifications and as supplemented herein.

B. Existing Roadways:
   1. Modify profile by grinding, milling, or overlay methods as approved, to provide meet lines and surfaces and to produce smooth riding connection to existing facilities.
   2. Remove existing material to a minimum depth of 1 inch.
   3. Paint edges to meet line with tack coat prior to placing new pavement.

C. Thoroughly coat edges of contact surfaces (curbs, manhole frames) with emulsified asphalt or asphalt cement prior to laying new pavement. Prevent staining of adjacent surfaces.

3.05 PAVEMENT APPLICATION

A. General: Place asphalt concrete mixture on approved, prepared subbase or base as applicable in accordance with the Standard Specifications and as shown on the Drawings.

B. Tack coat:
   1. Prepare material, as specified in the Standard Specifications prior to application.
   2. Apply uniformly to clean, dry surfaces avoiding overlapping of applications.
   3. Do not apply more tack coat than necessary for the day's paving operation.
   4. Touch up missed or lightly-coated surfaces and remove excess material.
   5. Application rate: Minimum 0.05 to 0.15 gallons per square yard of asphalt (residual if diluted emulsified asphalt) of surface area or as specified in the Standard Specifications, whichever is greater.

C. Pavement mix:
   1. Prior to paving:
      a. Sweep primed surface free of dirt, dust, or other foreign material.
      b. Patch holes in tack-coated surface with asphalt concrete pavement mix.
      c. Blot excess tack material with sand.
   2. Total compacted thickness: As shown on the Drawings.
   3. Apply such that meet lines are straight and edges are vertical.
   4. Collect and dispose of segregated aggregate from raking process. Do not scatter material over finished surface.
   5. Joints:
      a. Offset edge of each layer a minimum of 6 inches so joints are not directly over the underlying layer.
      b. Offset longitudinal joints in roadway pavements so longitudinal joints in wearing layer coincide with pavement centerlines and lane divider lines.
      c. Form transverse joints by cutting back on the previous day's run to expose full vertical depth of layer.
   6. Succeeding lifts: Apply tack coat to pavement surface between each lift.
   7. After placement of pavement, seal meet line by painting a minimum of 6 inches on each side of the joint with cut-back or emulsified asphalt. Cover immediately with sand.

D. Compaction:
   1. Comply with the requirements of the Standard Specifications.
   2. Joint compaction shall follow the requirements the Standard Specifications.

E. Tolerances: Tolerances shall comply with the Standard Specifications.

F. Seal coat:
   1. General: Apply seal coat of paving grade or emulsified asphalt to finished surface at longitudinal and transverse joints, joints at abutting pavements, areas where asphalt concrete was placed by hand, patched surfaces, and other areas as directed by the Engineer.
   2. Preparation:
      a. Surfaces that are to be sealed shall be maintained free of holes, dry, and clean of dust and loose material.
      b. Seal in dry weather and when temperature is above 35 degrees F.
   3. Application:
      a. Fill cracks over 1/16-inch in width with asphalt-sand slurry or approved crack sealer prior to sealing.
      b. When sealing patched surfaces and joints with existing pavements, extend a minimum of 6 inches beyond edges of patches.

3.06 PAVEMENT OVERLAY

A. Preparation:
   1. Pavement overlay preparation shall comply with the Standard Specifications.

B. Application:
   1. Pavement overlay application shall comply with the Standard Specifications.

3.07 PATCHING

A. Preparation:
   1. Remove damaged, broken, or unsound asphalt concrete adjacent to patches.
   2. Trim straight lines exposing smooth, sound, vertical edges.
   3. Prepare patch subgrade as specified in the Standard Specifications.

B. Application:
   1. Patch thickness: 3 inches or thickness of adjacent asphalt concrete, whichever is greater.
   2. Place asphalt concrete mix across full width of patch in layers of equal thickness.
   3. Spread and grade asphalt concrete with hand tools or mechanical spreader, depending on size of area to be patched.

C. Compaction: Follow compaction requirements specified in the Standard Specifications.

D. Tolerances: Comply with the Standard Specifications.

3.08 FIELD QUALITY CONTROL

A. General: Provide the services of an approved certified independent testing laboratory to conduct tests.

B. Field density tests:
   1. Perform tests from cores or sawn samples in accordance with AASHTO T230 and AASHTO T166.
   2. Measure with properly operating and calibrated nuclear density gauge in accordance with ASTM D2950.
   3. Maximum density: In accordance with ASTM D2041, using sample of mix taken prior to compaction from the same location as density test sample.

C. Testing frequency:
   1. Quality control test:
      a. Asphalt content, aggregate gradation: once per every 500 tons of mix or once every 4 hours, whichever is greater.
      b. Mix design properties, measured maximum (Rice's) specific gravity: Once every 1,000 tons or once every 8 hours, whichever is greater.
   2. Density tests: Once every 500 tons of mix or once every 4 hours, whichever is greater.

END OF SECTION

SECTION 32 17 13

PRECAST CONCRETE PARKING BUMPERS

PART 1 – GENERAL

1.1 SUBMITTALS

A. Product Data: Catalog cuts, specifications, and installation instructions for precast bumpers.

B. Quality Control Submittals:
1. Test Reports: Random freeze thaw tests shall be conducted by the manufacturer. Test specimens shall retain 60 percent of its initial modulus of elasticity after 300 cycles. Furnish test results to the Director upon request.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Precast Concrete: Normal weight, 5000 psi, air entrained concrete. Air content shall be 6 percent by volume within an allowable tolerance of plus or minus 1.5 percent.

B. Bar Reinforcement: ASTM A 615, Grade 40, deformed.

C. Setting Pins: 3/4 x 18 inches galvanized steel.

2.2 FABRICATION

A. Parking bumpers shall be cast at the manufacturer's plant, not at the job site. Castings shall have plane smooth surfaces, true to line and face, free from defects and sharp arises. Overall dimensions for castings shall not vary more than 1/16 inch from those indicated.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Center each unit between parking bay lines.

B. Anchor each parking bumper with two setting pins driven through precast or drilled holes into the subgrade or pavement below.

C. Reset existing parking bumpers approved for reuse by the Director's Representative.

3.2 FIELD QUALITY CONTROL

A. The Director may conduct additional tests. Replace units taken for testing, not to exceed 10 linear feet for each 1,000 feet or fraction thereof delivered to the project.

END OF SECTION

SECTION 32 17 21

PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:
1. Traffic lines and markings.
2. Legends.
3. Paint.
4. Glass beads.

B. Definitions:
1. Standard Specifications: State of New York, Department of Transportation (NYSDOT) Standard Specifications.

1.02 REFERENCE STANDARDS

A. The following is a list of standards which may be referenced in this Section:
1. American Association of State Highway and Transportation Officials (AASHTO):
a. M237, Standard Specification for Epoxy Resin Adhesives for Bonding Traffic Markers to Hardened Portland Cement and Asphalt Concrete.
b. M247, Standard Specification for Glass Beads Used in Traffic Paint.
c. M248, Standard Specification for Ready-Mixed White and Yellow Traffic Paints.
d. M249, Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form).
2. ASTM International (ASTM):
a. D4280, Standard Specification for Extended Life, Nonplowable, Prismatic, Raised Retroflective Pavement Markers.
3. Federal Specifications (FS):
a. A-A-2886A, Paint, Traffic, Solvent-Based.
b. TT-B-1325C, Beads (Glass Spheres); Retroflective.

1.03 SUBMITTALS

A. Action submittals:
1. Product Data for each product or material incorporated into the Work:
a. Paint.
b. Thermoplastic material.
c. Reflective markers
d. Epoxies, resins, and primers.

e. Glass beads: proposed gradation.

2. Manufacturer Instructions:
   a. Application temperatures, eradication requirements, application rate, line thickness, type of glass beads, and bead embedment and application rate.
   b. Installation requirements, including storage and handling procedures.
3. Qualifications Statements:
   a. Qualifications for manufacturer and applicator.
   b. Manufacturer's approval of applicator.

1.04 QUALITY ASSURANCE

A. The pavement marking Manufacturer shall have been in the active manufacture of specified products for at least three years.

B. Applicator:
   1. The Applicator shall be an individual or firm specializing in the proper installation of the pavement marking specified herein.
   2. The Applicator shall have a minimum of three years of experience in applying the pavement markings specified and shall be certified and approved by the Manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage:
   1. Store in accordance with the Manufacturer’s instructions.
   2. Paint:
      a. Invert containers several days prior to use if paint has been stored more than two months.
      b. Minimize exposure to air when transferring paint.
      c. Seal drums and tanks when not in use.
   3. Protection:
      a. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
      b. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.01 GENERAL

A. All products shall be in accordance with Section 640 and Section 727 of the NYSDOT Standard Specifications.

2.02 PAINT

A. Color: white, yellow, or blue (as approved by Engineer/Owner).

B. Traffic paint shall comply with Section 640-2 and Section 727-03 of the NYSDOT Standard Specifications.

C. Paint shall be homogeneous, easily stirred to smooth consistency, with no hard settlement or other objectionable characteristics during a storage period of 6 months.

2.03 THERMOPLASTIC MARKING

A. Color: white, yellow, or blue (as approved by Engineer/Owner).

B. Thermoplastic markings shall be in accordance with Section 737-01 of the NYSDOT Standard Specifications.

2.04 GLASS BEADS

A. Glass beads shall comply with Section 727-05 of the NYSDOT Standard Specifications.

PART 3 - EXECUTION

3.01 GENERAL

A. Surface Preparation, Application, and Protection: Comply with Section 635, Section 640, and Section 687 of the NYSDOT Standard Specifications.

3.02 APPLICATION

A. Do not apply materials if surface and ambient temperatures are outside temperature ranges required by pavement marking Manufacturer.

B. Do not apply exterior coatings during rain or snow if relative humidity is outside range required by Manufacturer, or if moisture content of surfaces exceeds that required by Manufacturer.

C. Minimum Conditions: Do not apply paint if temperatures are expected to fall below 55 degrees F within 24 hours after application.

D. Thermoplastic Compound: Do not apply unless pavement surface temperature is minimum 55 degrees F and rising.

E. Maximum VOCs: Do not exceed limit required by State or Environmental Protection Agency.

3.03 FIELD QUALITY CONTROL

A. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.

B. Acceptance:
   1. Repair lines and markings which, after application and curing, do not meet following criteria:
      a. Incorrect location.
      b. Insufficient thickness, width, coverage, or retention.
      c. Uncured or discolored material.
      d. Insufficient bonding.

3.04 CLEANING

A. Collect and lawfully dispose of residues from painting operations.

3.05 PROTECTION

A. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free.

B. Follow Manufacturer instructions or use minimum of 30 minutes of dry time.

END OF SECTION

SECTION 32 31 13.53

HIGH-SECURITY CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. High-security chain-link fences.
2. Swing gates.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for cast-in-place concrete equipment bases/pads for gate operators and controls and post footings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Fence and gate posts, rails, and fittings.
   b. Chain-link fabric, reinforcements, and attachments.
   c. Accessories: Barbed wire.
   d. Gates and hardware.
   e. Gate operator, including operating instructions and motor characteristics.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.
3. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
4. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For each type of factory-applied finish.

D. Delegated Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Professional Engineer.

B. Product Certificates: For each type of chain-link fence, operator and gate.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of high-security chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure to comply with performance requirements.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   c. Faulty operation of gate operators and controls.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design chain-link fence and gate frameworks.

B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated in accordance with ASCE/SEI 7:

1. Design Wind Load: As indicated on Drawings.
    a. Minimum Post Size: Determine in accordance with ASTM F1043 for post spacing not to exceed 8 feet for Material Group IA, ASTM F1043, Schedule 40 steel pipe.
    b. Minimum Post Size and Maximum Spacing: Provide line posts of size and in spacing indicated, but not less than sizes and spacings determined in accordance with CLFMI WLG 2445, based on mesh size and pattern specified.

C. Deflection Limits: Fence deflections shall be within the following limits:

1. Fabric Tension: Maximum 2.5 inches when tested by applying a 30-lbf force at midpoint between rails and horizontally between posts for every eighth lower panel along the fence line. Measure fabric movement from the relaxed position at the point where the force is applied.
2. Fence Post Rigidity: Maximum 3/4 inch when a 50-lbf force is applied at midheight of every eighth post along the fence line. Measure post movement from the relaxed position at the point where the force is applied.

D. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in height measured between top and bottom of outer edge of selvage in accordance with "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: One piece as indicated on Drawings.
    a. Steel Wire for Fabric: Wire diameter of 0.192 inch.
        1) Mesh Size: 2 inches.
2. Polymer-Coated Fabric: ASTM F668, Class 2b over zinc-coated steel wire.
    a. Color: As selected by Architect from manufacturer's full range, in accordance with ASTM F934.
3. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
4. Selvage: Twisted and barbed top and bottom.

2.3 SECURITY FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts.

1. Fence Height: As indicated on Drawings.
2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.
    a. Line Post: 2.875 inches in diameter
    b. End, Corner, and Pull Posts: 2.875 inches in diameter

3. Rail Members: top, bottom and brace rails in accordance with ASTM F1043 for Heavy Industrial.
4. Polymer coating over metallic coating.
    a. Color: As selected by Architect from manufacturer's full range, in accordance with ASTM F934.

2.4 SWING GATES

A. General: ASTM F900 for gate posts and single swing gate types.

1. Gate Leaf Width: 36 inches.
2. Framework Member Sizes and Strength: Based on gate fabric height of more than 72 inches.

B. Pipe and Tubing:

1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; manufacturer's standard protective coating and finish.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded or assembled with corner fittings and 3/8-inch- diameter, adjustable truss rods for panels 60 inches or wider.

D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend 12 inches above top of chain-link fabric at both ends of gate frame as required to attach barbed wire assemblies.

E. Hardware:

1. Hinges: 180-degree outward swing.
2. Latch: Permitting operation from both sides of gate.
3. Lock: Manufacturer's standard internal device.
4. Closer: Manufacturer's standard.
5. Tall Gates: For gates 14 feet and higher, add locking device to transom.

2.5 BARBED WIRE

A. Polymer-Coated, Galvanized-Steel Barbed Wire: ASTM F1665, Type II, two-strand barbed wire; 0.080-inch- diameter line wire with 0.080-inch- diameter, four-point, round galvanized-steel barbs spaced not more than 3 inches o.c.

1. Polymer Coating: Class 2b over zinc-coated steel wire.
    a. Color: As selected by Architect from manufacturer's full range in accordance with ASTM F934.

2.6 GATE OPERATORS

A. Operators: Factory-assembled, automatic gate-operating system designed for gate size, type, weight, and frequency of use. Control system shall have characteristics suitable for Project conditions, with control stations, safety devices, and weatherproof enclosures.

1. Operator design shall allow for removal of cover or motor without disturbing limit-switch adjustment and without affecting auxiliary emergency operation.
2. Electronic components shall have built-in troubleshooting diagnostic feature.
3. Unit shall be designed and wired for both right-hand/left-hand opening, permitting universal installation.

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. UL Standard: Manufacture and label gate operators in accordance with UL 325.

D. Motors: Comply with NEMA MG 1.

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
2. 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.
3. Service Factor: 1.15.
4. Electrical Characteristics:
    a. Horsepower: 2.
    b. Voltage: 208 V ac, three phase, 60 hertz.

E. Gate Operators: Gate (Swing Gate) mounted and as follows:

1. Hydraulic Swing Gate Operators:
    a. Duty: Heavy.
    b. Gate Speed: Minimum 45 feet per minute.
    c. Maximum Gate Weight: 800 lb.
    d. Frequency of Use: Continuous duty
    e. Operating Type: Wheel and rail drive with manual release.
    f. Hydraulic Fluid: Of viscosity required for gate operation at ambient temperature range for Project.
    g. Locking: Hydraulic in both directions.
    h. Heater: Manufacturer's standard track and roller heater with thermostatic control.
2. Mechanical Gate (Coiling Gate) Operators:
    a. Duty: Heavy.
    b. Gate Speed: Minimum 45 feet per minute.
    c. Maximum Gate Weight: 800 lb
    d. Frequency of Use: Continuous duty.
    e. Operating Type: Enclosed
    f. Drive Type:
        1) Enclosed worm gear reducers, roller-chain drive.
        2) V-belt and worm gear reducers, roller-chain drive.

F. Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA 250, Type 3R enclosure for pedestal mounting and with space for additional optional equipment.

G. Control Devices (Coiling Gate):

1. Telephone Entry System: Hands-free voice-communication system for connection to building telephone system, with digital-entry code activation of gate operator and auxiliary keypad entry.
   a. System: Designed to be wired to same line with telephone.
   b. Multiunit System: Designed to be wired to a dedicated telephone line, with capacity to access 20 telephones and with electronic directory.
2. Vehicle Loop Detector: System that includes automatic closing timer with adjustable time delay before closing, timer cut-off switch, and loop detector designed to open and close gate. Provide electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, and as recommended in writing by detection system manufacturer for function indicated.
   a. Loop: Factory-preformed wire, in size indicated, for pave-over installation.
3. Vehicle Presence Detector: System that includes automatic closing timer with adjustable time delay before closing, timer cut-off switch, and presence detector designed to open and close gate.
   a. Provide emitter/receiver detector with adjustable detection zone pattern and sensitivity, designed to detect presence or transit of a vehicle in gate pathway when an infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.

H. Emergency Release Mechanism: Quick-disconnect release of operator drive system, permitting manual operation if operator fails. Control circuit power is disconnected during manual operation.

1. Type: Mechanical device, key, or crank-activated release.

I. Operating Features:

1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability of monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
4. Automatic Closing Timer: With adjustable time delay before closing and timer cut-off switch.
5. Open Override Circuit: Designed to override closing commands.
6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
8. Clock Timer: Seven day, programmable for regular events.

J. Accessories:

1. Warning Module: Visual, strobe-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving and in accordance with the U.S. Access Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.
2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.
   a. Fail Safe: Gate opens and remains open until power is restored.
   b. Fail Secure: Gate cycles on battery power, then fail safe when battery is discharged.
3. External electric-powered magnetic lock with delay timer allowing time for lock to release before gate operates.
4. Fire strobe sensor.
5. Instructional, Safety, and Warning Labels and Signs: Manufacturer's standard for components and features specified.
6. Equipment Bases/Pads: Precast concrete, 6 to 12 inches below frost line, dimensioned and reinforced according to gate-operator component manufacturer's written instructions and as indicated on Drawings.

2.7 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION OF CHAIN-LINK FENCING

A. Install chain-link fencing in accordance with ASTM F567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
    b. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

D. Terminal Posts: Install terminal end, corner, and gate posts in accordance with ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more, at any abrupt change in grade, and at intervals not greater than 500 feet. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at 8 feet o.c.

F. Post Bracing and Intermediate Rails: Install in accordance with ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Barbed Wire Arms: Bolt or rivet to top of post. Angle single arms away from approach side of fence.

H. Tension Wire: Install in accordance with ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter

hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
2. Extended along top of barbed wire arms, extended posts and top of fence fabric to support barbed tape.
3. As indicated on drawings.

I. Top Rail: Install in accordance with ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

J. Bottom Rails: Secure to posts with fittings; anchor rail at midspan to concrete footing.

K. Chain-Link Fabric: Apply fabric on the approach side of fence, inside of enclosing framework. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

1. Overlapping Fabric: Overlap ends of fence fabric at or between posts or rails; overlap 6 inches and secure with wire ties or steel strap method.
2. Bottom Clearance: Leave 2 inches between finish grade or surface and bottom selvage unless otherwise indicated.

L. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.

M. Tie Wires: Power-fastened or manually fastened ties configured to wrap a full 360 degrees around rail or post and a minimum of one complete diamond of fabric. Twist ends one and one-half machine twists or three full manual twists, and cut off protruding ends to preclude untwisting by hand.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

N. Power-Fastening of Fabric: Fasten 0.192- or 0.148-inch wire fabric with 2- or 1-inch mesh size. Fasten fabric to line posts 12 inches o.c. and to braces 24 inches o.c.

O. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

P. Barbed Wire: Install barbed wire uniformly spaced, angled toward security side of fence. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.

Q. Barbed Tape: Install in accordance with ASTM F1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

R. Ground Barrier: Stake barbed-tape coils at 10 feet o.c., driven into ground to full depth.

3.4 INSTALLATION OF GATES

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 INSTALLATION OF GATE OPERATORS

A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation: Hand-excavate holes for posts, pedestals, and equipment bases/pads, in firm, undisturbed soil to dimensions and depths and at locations according to gate-operator component manufacturer's written instructions and as indicated.

C. Vehicle Loop Detector System: Bury wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

D. Ground electric-powered motors, controls, and other devices in accordance with NFPA 70 and manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests.

B. Perform the following tests:

1. Fabric Testing: Test fabric tension according to "Deflection Limits" Paragraph in "Performance Requirements" Article.
2. Fence Post Rigidity Testing: Test line posts for rigidity according to "Deflection Limits" Paragraph in "Performance Requirements" Article.
3. Grounding Tests.

C. Prepare test reports.

3.7 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Automatic Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.

1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.

2. Test and adjust operator, controls, alarms, and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Lubricate operator and related components.

C. Lubricate hardware and other moving parts.

END OF SECTION

SECTION 32 90 00

PLANTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Planting as shown on the Plans, as specified and/or directed.

1.02 SUMMARY

A. This Section includes the following:
   1. Shrubs
   2. Ground covers
   3. Plants
   4. Lawns
   5. Topsoil and soil amendments
   6. Fertilizers and mulches
   7. Landscape edgings

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 31 05 16, “Aggregates For Earthwork”

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
   1. Manufacturer's certified analysis for standard products.
   2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
   3. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.

C. Mulch sample: Six (6 oz.) ounces for each color and texture of mulch required in labeled plastic bags.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of

completed projects with project names and addresses, names and address of architects and owners, and other information specified.

E. Planting schedule indicating anticipated dates and locations for each type of planting.

F. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Landscape Architect's satisfaction, based on evaluation of agency- submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work.

C. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

D. Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

C. Sod: Harvest, deliver, store, and handle sod according to the requirements of the American Sod Producers Association's (ASPA) "Specifications for Turfgrass Sod Materials and Transplanting/Installing."

D. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.

E. Handle balled and burlapped stock by the root ball.

F. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
   1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   2. Do not remove container-grown stock from containers before time of planting.
   3. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.06 JOB CONDITIONS

A. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Landscape Architect before planting.

1.07 COORDINATION AND SCHEDULING

A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

1.08 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Warrant the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
   1. Trees
   2. Shrubs
   3. Ground covers
   4. Plants

C. Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season.

D. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

E. A limit of one replacement of each plant material will be required, except for losses or replacements due to failure to comply with requirements.

1.09 TREE AND SHRUB MAINTENANCE

A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings. Maintain trees and shrubs for 3 months following Substantial Completion.

1.10 GROUND COVER AND PLANT MAINTENANCE

A. Maintain ground cover and plants by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings. Maintain for 3 months following Substantial Completion.

1.11 LAWN MAINTENANCE

A. Begin maintenance of seeded lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than 3 months following Substantial Completion after date of Substantial Completion. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.

B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly healthy smooth lawn.

C. Watering: Water lawn at the minimum rate of 1 inch (25 mm) per week.

D. Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches (100 mm).

E. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.

F. Post Fertilization: Apply fertilizer to lawn after first mowing and when grass is dry. Use fertilizer that will provide actual nitrogen of at least 1 lb. per 1000 sq. ft. (0.5 kg per 100 sq. m) of lawn area.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS

A. The Contractor shall supply the type and quantity of plant materials indicated on the Contract Drawings. All plant materials shall conform to "American Standards for Nursery Stock Approved by the American Nursery & Landscape Association (ANLA)", latest edition. All plants shall be free from all pests and disease.

2.02 SMALL TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Grade: Provide small, uptight, multi-system trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.

D. Label at least 1 tree and 1 shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

2.03 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

B. Provide balled and burlapped deciduous shrubs.

C. Provide bare-root deciduous shrubs.

D. Provide balled and burlapped deciduous shrubs. Container-grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to meeting ANSI Z60.1 limitations for container stock.

2.04 GROUND COVERS AND PERENNIALS

A. Provide ground covers and plants established and well rooted in removable containers or integral peat pots and with not less than the minimum number and length of runners required by ANSI Z60.1 for the pot size indicated.

2.05 SOIL AMENDMENTS

A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 (2.36 mm) sieve and a minimum 75 percent passing a No. 60 (250 micrometer) sieve. Provide lime in the form of dolomitic limestone.

B. Aluminum Sulfate: Commercial grade, unadulterated.

C. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.

F. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.

G. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials. When site treated, mix with at least 0.15 lb. (2.4 kg) of ammonium nitrate or 0.25 lb. (4 kg) of ammonium sulfate per cu. ft. (cu. m) of loose sawdust or ground bark.

H. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

I. Herbicides: EPA registered and approved, of type recommended by manufacturer.

J. Water: Potable.

2.06 FERTILIZER

A. Bone Meal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
1. Composition: 1 lb. per 1000 sq. ft. (0.5 kg per 100 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

D. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 5 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight.
2. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
3. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.07 MULCH

A. Hard, durable, rounded, riverbed stone, washed free of loam, sand, clay, and other foreign substances, sized 1½" (max) – ¾" (min), in readily available natural color. Range to complement or match color range in the stone wall and veneer as acceptable to the Landscape Architect.

2.08 MULCH FOR SEEDED LAWNS

A. When not hydroseeding, shall be straw consisting of clean stalks of oats, wheat, rye, or other Landscape Architect approved crops well seasoned before bailing which are free of noxious weed seeds, roots, toxic materials, and growth or germination inhibitors.

B. When hydroseeding, shall be hydromulch containing pure wood fibers from clean wood chips. Chips shall be processed in such a manner to contain no lead paint, varnish, printing ink, petroleum based compounds, or seed germination inhibitors. The mulch shall contain a Colloidal Polysaccharide tackifier, adhered to the fiber during manufacturing to prevent separation during shipment and to avoid chemical agglomeration during mixing in the hydromulching equipment. The tackifier shall be homogeneous within the unit container. It shall have no growth or germination inhibitor and be non-toxic. Standard of quality shall be Hydromulch 2000 as manufactured by Conwed Fibers, 219 Simpson Street, Conover, NC 28613 (Telephone 800-366-1180), or Landscape Architect approved equal.

2.09 PLANTING ACCESSORIES

A. Planting soil mixture for trees, shrubs, perennials, and plant beds shall be premixed in bulk and contain the following by volume:

20.0 parts clean on site soil
10.0 parts topsoil
7.5 parts organic compost (25% of the volume of the above soils)

B. Topsoil: 5-20% organic, 20-65% passing 200 mesh sieve. Fertile, friable, natural topsoil of leafy character, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sand, stones, plants, roots, sticks, and other foreign materials, with acidity range of between pH6.5 and 7.5, free of substances harmful to plants which will be grown in the soil.

C. Starter fertilizer: Water soluble fertilizer and plant food 10-52-17 containing no sulfate or chloride salts. Standard of quality shall be as manufactured by Fairlawn Chemical Co., Inc., 485 Holt Road, Webster, NY (Telephone 716-787-2711) or Landscape Architect approved equal.

D. Organic compost: Shall be an all natural by-product of the brewing industry, locally available and free of weeds and substances harmful to plants which will be grown in the soil. It shall have a 7.2% pH, improve water absorption and retention capacity, contain microorganisms to improve biological activity in the soil and supply time released nitrogen and minerals. Standard of quality shall be NutriBrew as supplied by Commodity Specialists Company, P.O. Box 610, Baldwinsville, NY 13027 (Telephone 315-638-1113).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Lay out areas for multiple plantings. Stake locations, outline areas, and secure Landscape Architect's acceptance before the start of planting work. Make minor adjustments as may be required.
   1. Plant during season’s normal for work of this type as determined by accepted practice in locality, subject to the Engineer's approval.
   2. Stake all plant locations before digging, subject to the Engineer's approval.

3.03 PLANTING SOIL PREPARATION

A. Before bulk mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

B. Bulk mix soil amendments and fertilizers with topsoil at rates noted in the Planting Accessories (2.9 above). Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.

C. For tree pit or trench backfill, mix planting soil before backfilling and stockpile at site.

D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
   1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime from contacting roots of acid-tolerant plants.
   2. Apply phosphoric acid fertilizer, other than that constituting a portion of complete fertilizers, directly to subgrade before applying planting soil and tilling.

3.04 GROUND COVER AND PLANT BED PREPARATION

A. Loosen subgrade of planting bed areas to a minimum depth of 6 inches (150 mm). Remove stones larger than 1-1/2 inches (38 mm) in any dimension and sticks, roots, rubbish, and other extraneous materials.

B. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.

C. Till soil in beds to a minimum depth of 8 inches (200 mm) and mix with specified soil amendments and fertilizers.

D. Remove soil to a minimum depth of 8 inches (200 mm) and replace with prepared planting soil mixture.

3.05 PLANTING GROUND COVER AND PLANTS

A. Space ground cover and plants as indicated.

B. Dig holes large enough to allow spreading of roots, and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

3.06 MULCHING

A. Mulch backfilled surfaces of tree pits, hedge trenches, plant beds, and other areas indicated.

B. Apply three (3”) inches continuous thickness of mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.

END OF SECTION

SECTION 32 91 19.13

TOPSOIL PLACEMENT AND GRADING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Topsoil Placement and Grading as shown on the Plans, as specified, and/or directed.

1.02 SUBMITTALS

A. The Contractor shall provide a pH test and organic content test for the Engineer's review for each source of topsoil to be used.

1.03 QUALITY ASSURANCE

A. Topsoil will be visually inspected upon delivery and material that does not comply with the Specification will be rejected.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Topsoil
   1. Topsoil for such depth as directed shall be removed from areas of the site where excavations are to be made or embankments placed. The soil so removed shall be transported and stored in piles at convenient locations designated or approved and shall be kept separate from all other classes of excavated material. Should the Contractor fail to keep separate from other material any soil removed, he shall procure and furnish at his own expense an equivalent quantity of satisfactory topsoil.
   2. The Contractor is required to process the topsoil/compost. The material shall contain no admixture of refuse or any material toxic to plant growth and shall be free from subsoil, stones, clay lumps or similar objects larger than two inches in greatest dimension. Sod and herbaceous growth such as grass and weeds need not be removed. Topsoil shall not be delivered or placed in a frozen or muddy condition.
   3. Contractor to condition topsoil as necessary. Topsoil from on-site and off-site sources shall have an acidity range of pH 5.5 to 7.6 and shall contain 4 to 20% organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees C.
      a. Where topsoil pH is below 5.5, lime shall be added at a rate of 2-1/2 lbs. per cubic yard of topsoil until the pH is above 5.5.

b. Where topsoil pH is above 7.6, aluminum sulfate shall be added at a rate of 2-1/2 lbs. per cubic yard of topsoil until the pH drops below 7.6.

B. Soil Amendments

1. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.
2. Aluminum Sulfate: Commercial grade, in dry powder form.

PART 3 - EXECUTION

3.01 PLACEMENT

A. Topsoil shall include fine grading the surface of the ground upon which topsoil is to be placed and the furnishing and placing of topsoil in the areas to be seeded or planted.

B. Depth of topsoil shall be minimum 4 inches unless otherwise shown or directed.

C. After approval by the Engineer of the fine grading of the subgrade, the topsoil shall be spread and compacted with a light roller to the lines, grades and elevations shown on the drawings, or directed by the Engineer, without unsightly variations, ridges or other depressions which will hold water. Any stone, litter or objectionable material shall be removed from the topsoil and the surface raked to true lines. Any uneven spots shall be leveled. The work shall not be performed during unsuitable weather.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Seeding as shown on the Plans, as specified, and/or directed.

B. The Contractor shall seed new areas and disturbed areas where shown on the drawings, specified or directed by the Engineer. Contractor shall prepare the seed bed by scarifying or otherwise loosening soil to a depth of 2 inches, applying fertilizer, lime or aluminum sulfate, seed and mulch at the rates specified.

C. Topsoil shall be applied to the locations identified in the Contract Drawings.

1.02 SUBMITTALS

A. The Contractor shall submit to the Engineer for approval the method of seeding and the information outlined in Article 2.01.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fertilizer:
   1. Commercial fertilizer (30-0-4) shall contain not less than nineteen percent nitrogen, nineteen percent available phosphoric acid and nineteen percent water soluble potash. The fertilizer shall be inorganic or a combination of inorganic and organic substances.
   2. If, as an alternative, the Contractor wishes to substitute another fertilizer, he may do so with the approval of the Engineer, and the rate of fertilizer to be used shall be whatever amount is required to furnish the same amount of nitrogen as would be supplied by the 30-0-4.
   3. Commercial fertilizer shall be delivered in original bags of the manufacturer, showing weight, analysis and the name of the manufacturer.
   4. If the commercial fertilizer is not used immediately after delivery, the Contractor shall store it in such a manner that its effectiveness will not be impaired.

B. Seed:

1. Grass seed shall be a mixture of the species and/or varieties specified, mixed in the proportions specified.
2. The seed shall be fresh, recleaned and of the latest crop year. It shall conform to Federal and State Standards. Each type of grass in the mixture shall meet or exceed the minimum percentage purity and germination listed for that type of grass.
3. The following seed mixture shall be used for ditches, slopes and all areas disturbed by construction.

Percentage by Weight	Species or Variety	Percent Germination
30	Kentucky 31 Tall Fescue	90%
30	Perennial Ryegrass	90%
20	New Zealand White Clover	90%
20	Creeping Red Fescue	90%

4. For excessively wet areas, Reed Canary Grass shall be utilized.
5. The balance of material in an acceptable seed mixture, other than specified pure live seed shall, for the most part consist of nonviable seed, chaff, hulls, live seeds of crop plants and harmless inert matter. The percentage of weed shall not exceed one percent by weight for the mixture.
6. All seed mixtures furnished under this Item shall be mixed by the vendor and shall be delivered in standard sized bags of the vendor, showing the weight, analysis and vendor's name.
7. All seed shall be properly stored by the Contractor at the site of the work and any seed damaged during storage shall be replaced.

C. Mulch:

1. Straw or hay mulch shall consist of oats, wheat, rye or other approved crops which are free of noxious weeds. Weight shall be calculated on the basis of the straw having not more than 15% of moisture content.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Time For Seeding

1. Grass seed shall be sown from March 15th to June 1st or from August 15th to October 1st, unless otherwise approved by the Engineer. All seeding shall be done in a dry or moderately dry soil and at times when the wind does not exceed a velocity of five miles per hour. The Contractor is required to water seeded areas as necessary to provide favorable growing conditions as necessary.

B. Preparation of Seed Bed

1. After the finished grading is completed and just before seeding, the areas to be seeded shall be loosened to a depth of two inches and free from depressions which will hold water. All sticks, stones, clods, roots or other objectionable material which might interfere with the formation of a fine seed bed shall be removed from the soil.
2. Commercial fertilizer shall be evenly applied at the rate of 300 pounds per acre.

C. Seeding

1. Grass seed mixture shall be sown at the rate of 200 pounds per acre.
2. The seed shall be sown by hand or by an approved machine, in such a manner that a uniform stand will result.
3. After sowing, seeded areas shall be rolled with a light lawn roller weighing not more than one hundred pounds per foot of width.

D. Mulching

1. Within three days after the seed is sown, the seeded areas shall be covered with a uniform blanket of straw mulch at the rate of 1,000 pounds per acre of seeded area or as required to provide 90% coverage (i.e., lightly cover 90% of the surface).

E. Hydroseeding

1. The Contractor may substitute a hydroseeding process for hand seeding and mulching as specified above.
2. Where hydroseeding is used, the Contractor shall mix water, seed fertilizer, mulch and mulch anchorage at the following rates and apply to the prepared seed bed by means of a hand-held hose. No truck mounted spraying equipment shall be driven over the areas to be seeded. Discharge shall be in an uphill direction only.
   a. Fertilizer - 300 lbs. per acre
   b. Seed - 250 lbs. per acre
   c. Mulch coverage - Sufficient to equal 90% straw mulch
   d. Mulch Anchorage - Per Manufacturer's instructions
      Chemical 750 lbs. wood fiber/acre
      Wood Cellulose
3. Where the mulch anchorage is provided ready mixed with the mulch, no additional mulch anchorage will be required.
4. Mulch shall be a commercial cellulose hydromulch such as "Conwed 2000", "Turf Fiber", or equal. Soil seal or mulch anchorage used shall be approved by the Engineer. An asphalt emulsion shall not be used as mulch anchorage.

F. Maintenance and Protection

1. The Contractor shall maintain and protect all seeded areas until final acceptance of the Seeding portion of the Contract.
2. Final acceptance will not be made until an acceptable uniform stand of grass is obtained in all newly seeded areas except that the Engineer at his discretion may accept a portion or portions of the work at various times.
3. Upon final acceptance of a seeded area by the Engineer, the Owner will assume responsibility for maintenance and protection of that area.
4. Any portions of seeded areas which are unacceptable, and which fail to show a uniform stand of grass from any cause, shall be reseeded as before except the fertilizer shall be applied at one-half the original rate. The seeding shall be repeated until the seeded areas are satisfactorily covered with grass.

END OF SECTION

SECTION 33 11 16

SITE UTILITY PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Site Utility Piping as shown on the Plans, as specified and/or directed.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.
   1. American National Standards Institute (ANSI) Publications:
      a. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
      b. B16.3 - Malleable Iron Threaded Fittings
      c. B16.4 - Cast Iron Threaded Fittings, Class 125 and 250
      d. B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
      e. B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes
      f. B18.2.2 - Square and Hex Nuts
      g. B18.5 - Round Head Bolts (Inch Series)
      h. B88 - Seamless Copper Water Tube
      i. B843 - Magnesium Alloy Anodes for Cathodic Protection
   2. American Society for Testing and Materials (ASTM) Publications:
      a. A47 - Ferritic Malleable Iron Castings
      b. A48 - Gray Iron Castings
      c. A120 - Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, For Ordinary Uses
      d. A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile
      e. A536 - Ductile Iron Castings
      f. A563 - Carbon and Alloy Steel Nuts
      g. A746 - Ductile-Iron Gravity Sewer Pipe
      h. B32 - Solder Metal
      i. B61 - Steam or Valve Bronze Castings
      j. B62 - Composition of Bronze or Ounce Metal Castings
      k. B88 - Seamless Copper Water Tube
      l. C94 - Ready-Mixed Concrete
      m. D1527 - Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80
      n. D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

o. D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
p. D2241 - Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
q. D2282 - Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)
r. D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
s. D2468 - Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40
t. D2469 - Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80
u. D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
v. D2774 - Underground Installation of Thermoplastic Pressure Piping
w. D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
x. D3139 - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
y. F402 - Safe Handling of Solvent Cements and Primers Used for Joining Thermoplastic Pipe and Fittings
z. F477 - Elastomeric Seals (Gaskets) For Joining Plastic Pipe

3. American Water Works Association (AWWA) Publications:
a. C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water (ANSI/AWWA C104/A21.4)
b. C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
c. C110 - Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids
d. C111 - Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
e. C115 - Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
f. C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-lined Molds, for Water or Other Liquids
g. C153 - Ductile Iron Compact Fittings, 3 in. Through 12 in. (75 mm Through 300 mm), for Water and Other Liquids
h. C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipelines -- Enamel and Tape -- Hot-Applied
i. C500 - Gate Valves, 3 in. Through 48 in. NPS, for Water and Sewage Systems
j. C502 - Dry-Barrel Fire Hydrants
k. C503 - Wet-Barrel Fire Hydrants
l. C508 - Swing-Check Valves for Waterworks Service, 2 in. Through 24 in. NPS

m. C509 - Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems
n. C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
o. C606 - Grooved and Shouldered Type Joints (ANSI/AWWA C606)
p. C651 - Disinfecting Water Mains
q. C800 - Underground Service Line Valves and Fittings
r. C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water
s. M23 - PVC Pipe - Design and Installation

4. Copper Development Association, Inc., Publication:
   a. Copper Tube Handbook
5. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publication:
   a. SP-80 - Bronze Gate, Globe, Angle and Check Valves
6. Uniform Fire Prevention and Building Code of New York State Publications:
   a. 2015 International Plumbing Code
   b. 2016 New York State Uniform Code Supplement

1.03 DESIGN REQUIREMENTS

A. Water Service Lines: Provide water service line from water distribution main at building right-of-way to building service at point indicated. Water service lines shall be of seamless copper tubing. Provide water service line appurtenances where specified and where indicated.

1.04 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's standard drawings or catalog cuts for the following items, except where both are specified:
   1. Pipe and Fittings
   2. Joints and Couplings, including gaskets for joints (submit both drawings and cuts for push-on joints)
   3. Valves
   4. Curb or Service Stops
   5. Valve Boxes

B. Certificates of Compliance: Submit for each of the following materials:
   1. Pipe and Fittings, including shop-applied linings and coatings
   2. Pipe Joint Materials
   3. Valves

   Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests have been

performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage: Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping and jointing materials, and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

B. Handling: Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry, do not drag pipe to the trench. Store rubber gaskets and plastic piping and jointing materials that are not to be installed immediately, under cover out of direct sunlight.

PART 2 - PRODUCTS

2.01 WATER SERVICE LINE MATERIALS

A. Piping Materials:
1. Copper Tubing and Associated Fittings: Tubing shall conform to ASTM B88, Type K. Fittings for solder-type joint shall conform to ANSI B16.18 or ANSI B16.22; for compression-type joint shall conform to ANSI B16.26, flared tube type.

B. Valves, and Other Water Main Accessories:
1. Gate Valves on Buried Piping: MSS SP-80, Class 150, solid wedge, non-rising stem. Valves shall have flanged or threaded end connections, with a union on one side of the valve. Provide handwheel operators.
2. Valve Boxes: Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast-iron of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5-1/4 inches. Each cast-iron box shall have a heavy coat of bituminous paint.
3. Curb or Service Stops: Ground key, round way, inverted key type; shall be made of bronze conforming to ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be as appropriate for flared connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

4. Curb Boxes: Provide for each curb or service stop. Curb boxes shall be of cast-iron of a size suitable for the stop on which it is to be used. Provide a round head. Cast the word "WATER" on the lid. Each box shall have a heavy coat of bituminous paint.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPELINES

A. General Requirements for Installation of Pipelines: These requirements shall apply to pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

1. Location of Waterlines: The work covered by this Section shall terminate at a point approximately 5 feet from the building, unless otherwise indicated on the drawings. Do not lay waterlines in the same trench with gas lines or electric wiring.
2. Earthwork: Perform earthwork operations in accordance with Sections 31 23 16.13 and 31 23 43.
3. Pipe Laying and Jointing: Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or other waterline material into trenches. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade, and secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevents installation.
4. Connections to Existing Lines: Make connections in accordance with the recommended procedures of the manufacturer of pipe of which the line being tapped is made.

B. Installation of Water Service Lines:

1. Location: Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines at the point indicated; such water service lines shall be closed with plugs or caps.
2. Service Line Connections to Water Mains: Connect service lines 1-1/4 inch size to the main with a rigid connection or a corporation stop and goose neck and install a gate valve on service line below the frost line.
3. Special Requirements for Installation of Metallic Piping:
    a. Metallic Piping Installation, General: Install pipe and fittings in accordance with paragraph entitled, "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.
    b. Jointing:
        1) Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints for above ground pipe using ASTM B32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a resin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing with a flaring tool.

C. Disinfection: Flush and disinfect new potable waterlines and affected portions of existing potable waterlines in accordance with AWWA C651. Apply chlorine by the continuous feed method.

3.02 FIELD QUALITY CONTROL

A. Field Tests and Inspections: The Owner's Representative will conduct field inspections and witness field tests specified in this Section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed properly in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

B. Testing Procedure: Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements". Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper tubing joints soldered, compression type, or brazed.

C. Special Testing Requirements: For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

END OF SECTION

SECTION 33 41 00

SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE AND END SECTIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Smooth Interior Corrugated Polyethylene Pipe and End Sections as shown on the Plans, as specified and/or directed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Smooth interior corrugated polyethylene pipe shall conform to the requirements of Section 706-12 of the New York State Standard Specifications latest edition. The units shall conform to the shape, dimensions and thickness shown on the Contract Drawings or as listed in the Additional Instructions.

B. Polyethylene end sections shall conform to the requirements of Section 706-12 of the New York State Standard Specifications, latest edition.

C. All smooth interior corrugated polyethylene pipe and end sections shall be of the same manufacturer and shall be designed to be joined by couplings or other positive mechanical means approved by the Engineer.

2.02 SUBMITTALS

A. The Contractor shall submit six (6) copies of the manufacturer’s material specifications for each item to be supplied under this Section.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Smooth interior corrugated polyethylene pipe shall be installed in the locations shown on the Contract Drawings. Connections and embedment shall be performed in strict accordance with all manufacturer’s recommendations and as indicated on the drawings.

B. All pipe shall be laid in reasonably close conformity to line and grade and shall have a full firm and even bearing at each joint and along the entire length of pipe. Pipe laying shall begin at the downstream end and progress upstream. Any single run of pipe, including end sections, shall consist wholly of the same material unless otherwise directed by the Engineer.

C. All pipe shall be handled and assembled in accordance with the Manufacturer's instructions except as modified on the Plans or by the Engineer's written order.

D. Special care shall be exercised in placing and compacting material immediately adjacent to pipes in order to avoid damage to the pipe and to prevent pipe misalignment.

E. Movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be done at the Contractor's risk.

F. Corrugated polyethylene pipe connections for making field joints shall consist of corrugated bands, so constructed as to lap on equal portions of each culvert section to be connected. All connections shall be an approved type, fabricated and installed so that a secure and firm pipe connection may be readily made in the field.

END OF SECTION

SECTION 33 49 13

MANHOLES, MANHOLE FRAMES & COVERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Manholes, Manhole Frames & Covers as shown on the Plans, as specified, and/or directed.

PART 2 - PRODUCTS

2.01 DEFINITION

A. Standard and drop manholes shall be constructed of precast, reinforced concrete or poured in the field concrete bases, precast reinforced concrete riser sections and concentric or eccentric tapered tops, as shown on the Plans, specified, or directed.

2.02 MANHOLES

A. If the bases are poured in the field, they shall be constructed of Class "C" concrete to a point six (6) inches above the outside top of the main sewer.

B. The barrel of manholes shall be of precast, concrete sections of approved standard design of the manufacturer, and shall conform to ASTM Des: C478 latest edition for Precast Reinforced Concrete Manhole Sections, except as may be modified herein. Precast concrete manhole risers shall have a minimum nominal inside diameter of forty-eight (48) inches, when used on sewer lines up to and including twenty-one inches in diameter and sixty (60) inches for use on sewers twenty-four thru thirty-six inches in diameter. Special instructions will be furnished for construction of manholes for sewers of larger than 36 inch diameter.

C. Joints between precast reinforced concrete manhole sections shall be the rubber gasket type and shall conform to ASTM Des: C443 latest edition for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

D. Compressive strength of concrete used in risers shall be 4000 psi, and the maximum permissible absorption shall be eight (8) percent. Riser sections shall be reinforced with either one or two lines of steel, the total area per linear foot of which shall be not less than .0025 times the inside diameter in inches or .12 $in.^2$/linear foot minimum. Tapered sections, where required, shall be of the truncated cone design, having the same wall thickness and reinforcing as the cylindrical sections.

E. The Owner reserves the rights to choose either eccentric or flat slab tops at no additional charge.

F. Cored or Cast Arch or circular openings shall be provided in the manhole sections as required to receive lateral sewers or pipelines or drop pipes in drop manholes, as required. Manhole steps shall be of the type shown on the Contract Drawings and shall be arranged and spaced as shown on the Contract Drawings.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Precast concrete pipe sections shall fit together readily, and all joints shall have all voids filled with cement mortar applied, both inside and outside the manhole. The top of the uppermost ring or truncated cone shall be formed to receive the manhole frame and cover, or other appurtenant casting.

B. The bench walls of standard and drop manholes shall be constructed of Class "C" concrete as shown on the drawings. The top of the bench wall shall have an increasing slope away from the channel. All channels shall be constructed to conform to the invert of the pipe and permit a smooth and uninterrupted flow through the manhole.

C. Drop manholes shall consist of a standard manhole having a drop of pipe installed as shown on the Drawings. All pipe and fittings at the top and the one at the bottom of the drop shall be included and constructed as part of the manhole as shown on the drawings.

D. Where masonry courses are required to bring manhole frames to grade, top ring or cone sections shall have a flat surface formed to receive the first course of brick masonry.

E. Ground water test pipes shall be provided in each manhole if required on the Contract Drawings. The test pipes shall be 3/4" diameter galvanized steel with hot dip bituminous coating, nine inches long with a ninety degree elbow and threaded cap. The test pipe shall be set at an elevation of two inches above the bench wall and eight inches from the center line of the manhole steps. The pipes shall be grouted into the precast manhole wall with a non-shrink grout.

F. Manholes upon completion shall be watertight.

3.02 PIPE TO MANHOLE CONNECTIONS

A. All concrete pipe shall be grouted into manhole walls with non-shrink grout.

B. All other pipe materials shall be connected to manholes by means of a resilient and watertight flexible connection.

C. Resilient connectors shall conform to ASTM C923.

D. Where resilient connectors are installed, concrete used to form the manhole channel shall not be permitted under the pipe protruding through the manhole wall. Oakum or Styrofoam shall fill the void under the protruding pipe to maintain the connection flexibility. The concrete channel shall meet the pipe invert as shown.

3.03 COMPLETION

A. Manholes, in all cases, shall be completely constructed and fitted with their frames and covers as the work progresses and as each structure is reached. After the final inspection and acceptance of the pipeline or other facility served by the manholes, the Contractor shall, unless otherwise ordered, seal all covers with an approved fibrated mastic compound.

B. The Contractor shall, at his own cost and expense, reset any and all manhole frames and covers, as required, to meet the finished grade of pavements replaced by the Contractor as specified herein.

3.04 ALTERNATIVE CONSTRUCTION

A. Manholes may be constructed of alternative materials provided such manholes are submitted to the Engineer for approval prior to construction.

3.05 MANHOLE VENTS

A. Manholes with waterproof frames and covers shall be provided gas vents when specified, shown or as directed by the Engineer. Payment for gas vents shall be included in the unit price for waterproof frames and covers.

3.06 CASTINGS

A. Manhole frames and covers, grates, inlets, steps and other castings shall be in accordance with ASTM Des: A48, Grade 30. They shall be equal in quality and at least equal in weight to those referred to on the Plans by the manufacturer's catalog numbers. When specified or shown, manhole covers shall have the name of the Owner in addition to the word "Sewer" or other appropriate designation cast as shown on the Plans. Manhole frames and covers shall be supplied with eccentric cam lug locking devices, when specified or shown. All manholes, grates, manhole frames and grate frames shall be machined to provide non-rocking covers or grates.

3.07 PAINTING AND WATERPROOFING

A. All castings shall be thoroughly cleaned and free from rust. All manholes shall be waterproofed on the outside with two coats of bituminous coal tar coating as manufactured by Koppers "Bitumastic Super Service Black", Mobil "Hi-Build Bituminous Coating" or equal.

3.08 LEAKAGE TEST

A. All manholes shall be tested for leakage by filling the structures with water and observing the drop in the water surface elevation for a period of 24 hours.

B. Allowable leakage shall be as defined by the specification for Non-Pressure Sewers.

END OF SECTION

SECTION 44 56 00

WASTE HANDLING AND DISPOSAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Waste Handling and Disposal, as shown on the Plans, specified, and/or directed.

B. Waste to be handled and disposed of includes excess waste from construction activities.

1.02 REFERENCES

A. The publications listed below and their latest revisions form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The publications are identified for information only and do not represent all regulations, codes, or standards which may apply to this work.

1. Occupational Safety and Health Administration (OHSA) Regulations
    a. 29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response
    b. 29 CFR Part 1910.146 - Permit-Required Confined Spaces
    c. 29 CFR Part 1910 - Occupational Safety and Health Standards
    d. 29 CFR Part 1926 - Occupational Safety and Health Standards for Construction
2. United States Environmental Protection Agency (EPA) Regulations
    a. 40 CFR Parts 260-269 - Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management and Regulations
3. New York State Department of Environmental Conservation (DEC) Regulations
    a. 6 NYCRR Parts 370-374 - Hazardous Waste Management Regulations
    b. 6 NYCRR Part 360-363 - Solid Waste Management Regulations
    c. 6 NYCRR Part 364 - Waste Transporter Regulations
    d. 6 NYCRR Parts 612-614 - Petroleum Bulk Storage
    e. TAGM 4046 - Determination of Soil Cleanup Objectives and Cleanup Levels

1.03 HEALTH AND SAFETY

A. Additionally, all site activities shall be conducted in accordance with all pertinent general industry (29 CFR Part 1910) and construction (29 CFR Part 1926) Occupational Safety and Health Administration (OSHA) standards, and other applicable New York State and municipal codes and ordinances.

B. The Contractor shall also develop and implement a site specific Health and Safety Plan that addresses possible hazards associated with the waste excavation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Waste shall be adequately covered, secured and stored at the end of each work day.

PART 3 - EXECUTION

3.01 WASTE HANDLING AND DISPOSAL

A. Waste shall be removed from the work site and shall be properly disposed of at no additional cost to the Owner.

END OF SECTION