



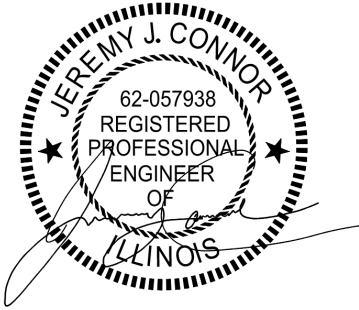
PROJECT MANUAL FOR

ATHLETIC TRAINING FACILITY
WABASH VALLEY COLLEGE
ILLINOIS EASTERN COMMUNITY COLLEGES
2200 COLLEGE DRIVE,
MT. CARMEL, WABASH CO., ILLINOIS
HR# 395-3272



Prepared for

Illinois Eastern Community Colleges
Olney, Richland County, Illinois



April 23, 2024



Bid Package No. _____

HURST-ROSCHE INC.

200 North Market Street,

Marion, Illinois 62959

618/998-0075

DOCUMENT 00 01 10

ATHLETIC TRAINING FACILITY
WABASH VALLEY COLLEGE
ILLINOIS EASTERN COMMUNITY COLLEGES
2200 COLLEGE DRIVE
MT. CARMEL, WABASH CO., ILLINOIS
HR # 395-3272

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INVITATION TO BID

Project: ATHLETIC TRAINING FACILITY
WABASH VALLEY COLLEGE
ILLINOIS EASTERN COMMUNITY COLLEGES
2200 COLLEGE DRIVE
MT. CARMEL, WABASH CO., ILLINOIS
HR# 395-3272

Owner: ILLINOIS EASTERN COMMUNITY COLLEGES
233 EAST CHESTNUT
OLNEY, IL 62450

Architect/Engineer: HURST-ROSCHE, INC.
200 N. MARKET STREET
MARION, IL 62959

Date: **April 23, 2024**

The Owner will receive sealed bids **until 02:00 PM local prevailing time on Tuesday the 4th day of June 2024, at the Illinois Eastern Community Colleges District 529 Office,** located at 233 East Chestnut Street, Olney, IL 62450 for the following work:

Project Description:

Construction of a new 8450 square foot athletic training facility for Wabash Valley College. The construction will consist of a pre-engineered metal building with concrete foundation containing; a training area for soccer and baseball featuring an enclosed athletic netting system with synthetic turf floor, three locker rooms, a concession area with casework, two public restrooms, a second floor storage area, exterior barrier netting, a parking area, and utility work. The work includes, but is not limited to architectural, structural, civil, electrical, mechanical, and plumbing work.

A Pre-bid Meeting will be held on **Wednesday, May 15, 2024, at 10:00 AM**, prevailing time, at **the Wabash Valley College Campus, Main Hall Room 101, located at 2200 College Drive, Mt. Carmel, IL 62863**. An opportunity to visit the site will follow.

Drawings and specifications may be obtained at the office of Hurst-Rosche, Inc., 200 N. Market Street, Marion, Illinois, **April 23, 2024**, by paying a nonrefundable amount of \$100.00 (\$150.00 if mailed) for each set of drawings and specifications.

Bidding Documents, Drawings and Specifications, may be examined by prospective bidders and material suppliers at the offices of Hurst-Rosche, Inc., 200 N. Market Street, Marion, Illinois 62959, and at the Illinois Eastern Community Colleges District 529 Office, 233 East Chestnut Street, Olney, Illinois 62450, as well as the following Plan Rooms:

McGraw-Hill Construction
www.dodgeprojects.construction.com

iSqFt Planroom
9901 Allisonville Road
Fishers, IN 46038

AGC of Western Kentucky
2201 McCracken Blvd.
Paducah, KY 42002-1059

Southern Illinois Builders Association
504 West Jackson
Marion, IL 62959

Reed Construction Data
www.reedepr.com

Drawings and specifications will be available for viewing on the internet at: hurst-rosche.com/contractors. The documents are being provided for reference purposes only. Potential Bidders who take a copy of the documents must contact the Marion Office of **Hurst-Rosche, Inc.** via email or phone, and inform them that they have taken the documents for review. Bidders must obtain a signed and sealed set of the bidding documents, including bid form, from the offices of **Hurst-Rosche, Inc.** to submit a bid for this project.

The Owner requires the project to be substantially complete by June 18, 2025.

Bidders will be required to provide Bid security of a sum no less than 5 percent of the Bid Sum. The bid security shall be in the form of a certified check, cashier's check, bank money order or bid bond issued by surety licensed to conduct business in the State of Illinois. Hereinafter this bid security shall be referred to as the bid bond.

Submit two copies of your Bid on the Bid Form provided. Bidders may supplement this form as appropriate.

Your Bid will be required to be submitted under a condition of irrevocability for a period of 60 days after submission.

Successful bidders shall be required to observe Illinois Public Act 77-1552 and the Illinois Department of Human Rights and Illinois Human Rights Commission Rules pertaining to Equal Employment Opportunity as provided for in paragraphs 2-101, et seq., Article II, Chapter 68, of the Illinois Revised Statutes; and comply with paragraph 271 of Chapter 48 of the Illinois Revised Statutes concerning the employment of citizens of the State of Illinois; and comply with Chapter 48, Sections 39s-1 through 39s-12, of the Illinois Revised Statutes, as amended, known as the Prevailing Wage Determination, as issued by the Illinois Department of Labor.

The Owner reserves the right to accept or reject any or all Bids or any part thereof, to waive any informality in bidding, and to accept bids deemed most favorable to the Owner.

CLIENT'S NAME

ILLINOIS EASTERN COMMUNITY COLLEGES

DR. RYAN GOWER, CHANCELLOR

END OF DOCUMENT

BID FORM - STIPULATED PRICE

To: ILLINOIS EASTERN COMMUNITY COLLEGES
233 EAST CHESTNUT STREET
OLNEY, IL, 62450

Project: ATHLETIC TRAINING FACILITY
WABASH VALLEY COLLEGE
ILLINOIS EASTERN COMMUNITY COLLEGES
2200 COLLEGE DRIVE
MT. CARMEL, WABASH CO., ILLINOIS
HR# 395-3272

Date: _____

Submitted by: _____
(full name)

(full address) _____

Contact Name: _____

1. OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Contract Documents prepared by Hurst-Rosche, Inc. for the above-mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

Base Bid:

\$ _____ dollars, in
lawful money of the United States of America.

Alternates

Alternate No. 1: Painting of angled stripes on exterior panels, east and west elevations.
Approximately 220 square feet, with final color and design layout to be coordinated with owner.

\$ _____ dollars, in
lawful money of the United States of America.

We have included the security Bid Bond as required by the Instruction to Bidders.

All applicable federal taxes are excluded and State of Illinois taxes are excluded from the Bid Sum.

2. REVIEW OF BID DOCUMENTS

The bidder represents that they are skilled and experienced in the use and interpretation of drawings and specifications such as those included in the bid documents for this contract. They have carefully reviewed the drawings, specifications and other bid documents, and have found them free of ambiguities and sufficient for bid purposes. Further, the Bidder has carefully examined the site of the work and, from their own observations, has satisfied themselves as to the nature and location of the work; the character, quality and quantity of materials; the difficulties likely to be encountered; and any other items which may affect the performance of the Work. They have based their bid solely on these documents and observations, and have not relied in any way on any explanation or interpretation, oral or written, from any other source.

3. CONTRACTOR’S FEE FOR CHANGES IN WORK

Undersigned herein indicates a single percentage, not to exceed 12% for own forces and not to exceed 8% for subcontractors, for overhead and profit to be added to net extra job cost for changes in the work required to be performed by:

a) Own Forces ___% b) Subcontractors ___%

Undersigned herein indicates a single percentage, not less than 10% for own forces and not less than 5% for subcontractors, for overhead and profit to be added to net credit for job costs for changes in the work required to be performed by:

a) Own Forces ___% b) Subcontractors ___%

Percentages named above shall not include any items of insurance, bond or taxes since these are considered job cost items in contractor's quotations for changes in the work.

Any percentages indicated which are higher or lower than the maximum or minimum in the typewritten language herewith, shall be disregarded and typewritten figure used.

4. CONTRACT TIME

Undersigned agrees that, if awarded the Contract for Work bid upon herein, work will start on date designated in a written Notice to Proceed order issued by the Architect and will be completed in accordance with the contract documents, with all phases of work completed and operational and ready for acceptance by the Owner no later than as required by the Contract Agreement.

5. ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

Addendum # _____ Dated _____; Addendum # _____ Dated _____
Addendum # _____ Dated _____; Addendum # _____ Dated _____

6. APPENDICES

The following documents are attached to and made a condition of the Bid:

- Bid Bond in form of
- Bidder's qualifications statement and supporting data.
- Document 00 43 00 – Procurement Form Supplements
- Appendix A - List of Subcontractors.

7. EQUAL EMPLOYMENT OPPORTUNITY

During performance of this contract, Contractor agrees as follows:

- a. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.
- b. The contractor will in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.
- c. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract of understanding, notice advising the labor union or worker's representative of the contractor's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- d. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and by the rules, regulations, and relevant orders of the Secretary of Labor.
- e. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and order of the Secretary of Labor pursuant thereto, and will permit access to his books, records and accounts by the Department of the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.
- f. In the event of the contractor's non-compliance with the nondiscrimination clauses of this contract or with any such rules, regulations or orders, this contract may be canceled, terminated or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies involved as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.
- g. The contractor will include the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations or orders of the

Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the Department may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the contractor becomes involved in, or is threatened with, litigation with the subcontractor or vendor as a result of such direction by the Department, the contractor may request the United States to enter into such litigation to protect the interest of the United States.

8. BUSINESS ENTERPRISE PROGRAM (BEP)

Any Certified Vendor (Primary Contractor, Sub-Contractors, or Procurement/Material Vendors) in accordance with the Business Enterprise Program (BEP) for Minorities, Females, and Persons with Disabilities Act:

YES _____ NO _____

If YES, you must attach a copy of the current letter of certification from each Certified Vendor.

Percentage of overall work (material and/or labor) being provided by BEP Certified Vendor(s):

_____ %

9. NOT BARRED

The contractor by submitting its bid certifies that the Contractor is not barred from bidding on the contract as a result of a conviction for either bid-rigging or bid-rotating. 720 ILCS 5/33/E-11.

10. DRUG FREE WORKPLACE

The Contractor by submitting its bid certifies that it will provide a drug free workplace and that it is in compliance with the requirements of the Drug Free Workplace Act 30 ILCS 580.1 et. seq., and the Substance Abuse Prevention on Public Works Projects Act PA095-0635.

11. SEXUAL HARASSMENT POLICY

The Contractor by submitting its bid certifies that it has a written sexual harassment, (ii) a description of sexual harassment, utilizing examples; (iv) an internal complaint process including penalties (v) the legal resource, investigative and compliant process through the Illinois Department of Human Rights; (vi) directions on how to contact the Department and Commission; and (vii) protection against retaliation for exercising rights under the policy in accordance with 775 ILCS 5/2-105(A)(4).

11. CRIMINAL RECORDS CHECKS

The Contractor by submitting its bid certifies that it will submit to background screening those employees, including subcontract employees, which will be working on any district project. This information is to be provided in accordance with the requirements of 105 ILCS 5/10-21.9. The Contractor by submitting its bid understands that employees found to be in violation of the Illinois School Code will not be permitted to work on school grounds.

12. BID FORM SIGNATURES

The Corporate Seal of

(Bidder - print the full name of your firm)
was hereunto affixed in the presence of:

(Authorized signing officer Title)

(Seal)

(Authorized signing officer Title)

(Seal)

If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF DOCUMENT

PROCUREMENT FORM SUPPLEMENTS

To: **ILLINOIS EASTERN COMMUNITY COLLEGES
233 EAST CHESTNUT STREET
OLNEY, IL, 62450**

Project: **ATHLETIC TRAINING FACILITY
WABASH VALLEY COLLEGE
ILLINOIS EASTERN COMMUNITY COLLEGES
2200 COLLEGE DRIVE
MT. CARMEL, WABASH CO., ILLINOIS
HR# 395-3272**

Date: _____

Submitted by: _____
(full name)
(full address) _____

In accordance with Document 00 21 14 - Instructions to Bidders - AIA and Document 00 41 13 - Bid Form - Stipulated Price, we include the Appendices to Bid Form Supplements listed below. The information provided shall be considered an integral part of the Bid Form.

The following Appendices are attached to this document:

- Appendix A - List of Subcontractors: Include names of all Subcontractors and portions of the Work each Subcontractor will perform. Those firms listed can't be changed without approval by the owner and the Architect. Appendix A is required to be provided within 24 hours of the bid opening.
- Appendix B – List of Alternates

BID FORM SUPPLEMENTS SIGNATURES

The Corporate Seal of

(Bidder - print the full name of your firm)

was hereunto affixed in the presence of:

(Authorized signing officer Title)

(Seal)

(Authorized signing officer Title)

APPENDIX A - LIST OF SUBCONTRACTORS

Herewith is the list of subcontractors referenced in the bid submitted by:

(Bidder) _____

To (Owner) ILLINOIS EASTERN COMMUNITY COLLEGES

Dated _____ and which is an integral part of the Bid Form.

The following work will be performed (or provided) by subcontractors and coordinated by us:

WORK SUBJECT	NAME
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

APPENDIX B - LIST OF ALTERNATES

The following is the list of alternates referenced in the bid submitted by:

(Bidder) _____

To (Owner) ILLINOIS EASTERN COMMUNITY COLLEGES

Dated _____ and which is an integral part of the Bid Form.

The following amounts shall be added to or deleted from the Bid Sum.

Alternate No. 1: Painting of angled stripes on exterior panels, east and west elevations. Approximately 220 square feet, with final color and design layout to be coordinated with owner.

Add \$ _____

END OF DOCUMENT

DOCUMENT 00 52 14

AGREEMENT – AIA STIPULATED SUM

1.1 SUMMARY

- A. Document Includes:
 - 1. Contract Agreement.
- B. Related Documents:
 - 1. Document 00 72 14 – General Conditions – AIA Stipulated Sum.
 - 2. Document 00 73 13 – Supplementary Conditions – AIA.

1.2 CONTRACT AGREEMENT BETWEEN OWNER AND CONTRACTOR

A. THIS AGREEMENT, made and entered into as of the _____ day of _____ in the year of Two Thousand and Twenty Four by and between _____ hereinafter and in the Contract Documents called "Contractor" and the ILLINOIS EASTERN COMMUNITY COLLEGES hereinafter and in the Contract Documents called "Owner."

B. WITNESSETH: That for and in consideration of the mutual covenants and agreements, hereinafter stated, Contractor and Owner covenant and agree as follows:

C. THE CONTRACT WORK:

- 1. Contractor covenants and agrees to furnish all labor, materials, equipment, transportation, construction plant and facilities necessary to perform all Work required by the Contract Documents, for the Project entitled:

**ATHLETIC TRAINING FACILITY
WABASH VALLEY COLLEGE
ILLINOIS EASTERN COMMUNITY COLLEGES
2200 COLLEGE DRIVE
MT. CARMEL, WABASH CO., ILLINOIS
HR# 395-3272**

as shown on Drawings and described in Specifications prepared by Hurst-Rosche Inc., 200 N. Market Street, Marion, Illinois, acting as, and in these Contract Documents referred to as Architect/Engineer and covenants and agrees to do and perform all acts and things required of Contractor by this Contract and the Contract Documents.

D. TIME OF COMPLETION:

- 1. Work performed under this Contract shall be commenced on date stipulated in written Notice to Proceed and, subject to authorized adjustments; Substantial Completion shall be achieved no later than June 18, 2025.
- 2. It is expressly understood that time is of the essence in this Contract and that a

delay in the Substantial Completion of the Work beyond that provided for in Paragraph D.1 above would cause damages to the Owner, the amount of which would be difficult, if not impossible, to estimate and prove. Accordingly, if the Contractor fails to complete the Work within the period of time set forth above, subject to any time extensions permitted hereunder for excusable delays or Owner-requested changes, the Contractor shall pay to the Owner as liquidated damages and not as a penalty, the stipulated sum of One Thousand Dollars (\$1,000.00) for each calendar day or portion thereof that Substantial Completion is so delayed.

E. CONTRACT SUM AND TERMS OF PAYMENT:

1. Contract Sum: The Owner, if Contractor shall faithfully fulfill and perform this Contract, covenants and agrees to pay Contractor in current funds, subject to additions and deductions by Change Order as provided in the Contract Documents, the sum of _____ Dollars (\$_____), which sum shall constitute the Contract Sum, said Contract Sum being derived from Contractor's Bid dated _____. It is understood and agreed that should there be any increase in wage rates, or in cost of materials or equipment, or in any other of Contractor's costs or should Contractor be compelled to pay premium wages, or for overtime work, during the life of this Contract and/or prior to completion of Contractor's work thereunder, Contractor shall absorb all such increased costs, without addition to the Contract Sum except when otherwise expressly provided in Contract Documents.
3. Payments: Owner shall make payments for work performed under the Contract as provided in Article Nine of the General Conditions and in accordance with other applicable articles of the Supplementary Conditions and Contract Documents.
4. Contractor's Fees for Changes in Work: In accordance with Contractor's bid, it is agreed that the following percentages for overhead and profit shall be applied on work added to or omitted from the Contract by written Change Order approved by Architect and Owner in advance of performance of the work.

Additional Work performed by:

- | | |
|--------------------|------------------------|
| 1. Own Forces ___% | 2. Subcontractors ___% |
|--------------------|------------------------|

Omitted Work originally required by:

- | | |
|--------------------|------------------------|
| 1. Own Forces ___% | 2. Subcontractors ___% |
|--------------------|------------------------|

F. CONTRACT DOCUMENTS:

1. Contract Documents include the Contract Agreement, Contractor's Bid as accepted by Owner, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, and all Addenda issued prior to and all Modifications issued after execution of the Contract Agreement.
2. Bidder's attention is directed to the fact that all Federal and Illinois State Laws, municipal ordinances and regulations of any and all authority 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. Successful Bidders shall be required to comply with 777 ILCS 10 concerning equal employment opportunities; comply with 30 ILCS 570 concerning the employment of citizens of the State of Illinois; comply with 820 ILCS 265 concerning substance abuse prevention on public works projects; and comply with 820 ILCS 130 concerning prevailing wages.

G. ILLINOIS LABOR:

Contractor shall comply with all Illinois statutory requirements regarding labor, including, but not limited to, the following:

1. Illinois Public Act 77-1552 and Chapter 48, Sections 39S-1 through 39S-12 of the Illinois Revised Statutes regulating wages of laborers, mechanics and other workers employed in any public works and known as the "Prevailing Wage Act," which provides in part that all laborers, mechanics and workers performing work under the Contract shall be paid not less than the prevailing rate of wages as determined by the Illinois Department of Labor (820 ILCS 130).
2. Illinois Public Act 83-1472, Article 2 and Chapter 48, Sections 2201 through 2207, 1984 of the Illinois Revised Statutes pertaining to hiring of Illinois labor and known as the "Illinois Preference Act (30 ILCS 570)."
3. "Illinois Human Rights Act of 1980," Chapter 68, Illinois Revised Statutes, and the Rules and Regulations, Title 44, Section 750 of the Illinois Administrative Code, Illinois Department of Human Rights; pertaining to equal employment opportunity (777 ILCS 10).

H. PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND:

1. Within fifteen (15) days immediately following date of his receipt of this contract, Contractor shall furnish Owner the signed Contract and Performance Bond and Labor and Material Payment Bond as required by and in accordance with the terms of Contract Documents in a penal sum of one hundred percent (100%) of the Contract sum.
2. In the event Contractor fails to furnish Owner such Contract and Bonds within said period, this Contract shall thereupon become null and void at Owner's option, exercised by written registered notice and mailed to Contractor by said Owner within five (5) days thereafter. Owner may then retain and enforce as liquidated damages, bid guarantee heretofore deposited with it in connection with Contractor's proposal for this Contract or the difference between his bid and a subsequent awarded bid, whichever is lesser.

I. IN WITNESS HEREOF, the parties hereto have executed this agreement as of the day and year first written above.

OWNER:

ILLINOIS EASTERN COMMUNITY COLLEGES

BY _____

TITLE _____

CONTRACTOR:

Attest:

BY _____
Secretary

BY _____

TITLE _____

END OF DOCUMENT

CONTRACTOR'S AFFIDAVIT FOR FINAL COMPLETION
(To be filed with final request for payment)

STATE OF _____)

COUNTY OF _____)

_____, being
first duly sworn upon oath deposes and says:

That he/she is _____ of _____

hereinafter termed "The Contractor" for all work upon the hereinafter termed "Said Project," work for the ILLINOIS EASTERN COMMUNITY COLLEGES, under that certain contract between said Contractor and said Owner, bearing date of _____ pertaining to said work.

Affiant further states, of his/her own knowledge, that all bills incurred by the Contractor, for services, labor and material furnished, for work done by the Contractor under said Contract, or in connection with said project have been paid and all subcontractors who have furnished services, labor or materials have no claim or demand against Owner for any services, labor and/or materials furnished and/or work done by them upon said Project.

Affiant further states that this affidavit is made on behalf of the Contractor for the purpose of obtaining payment of the sum of

_____ (\$ _____) dollars, which affiant states, upon his/her own knowledge, constitutes the full balance due the Contractor for all services, labor and materials furnished and work done to and upon Said Project by the Contractor whether under and pursuant to provisions of said Contract and all subsequent modifications thereof and changes therein or otherwise; and that payment of the sum to the Contractor will constitute payment in full on everything due for such services, labor, materials and work, and will fully satisfy any and all claims or demands which Contractor may have or assert against said Owner, arising out of anything done or furnished by the Contractor or occurring in connection with said Project and/or Contract.

CONTRACTOR

Subscribed and Sworn to before me the _____ day of _____, 20____.

NOTARY PUBLIC

CONTRACTOR'S RELEASE AND WAIVER OF LIEN
(PARTIAL) (FINAL)

TO WHOM IT MAY CONCERN:

For good and valuable consideration, the receipt and sufficiency of which is

hereby acknowledged, the undersigned _____

_____,
hereinafter termed "Contractor," hereby waives and releases any and all liens,
and any and all claims and rights to liens against the **Athletic Training Facility at Wabash Valley College**, hereinafter termed "Said Project," and any and all other property owned by or the title to which is in the name of the ILLINOIS EASTERN COMMUNITY COLLEGES hereinafter termed "Owner" and upon construction and/or equipping of Said Project, any and all warrants drawn upon or issued against any such funds or monies which Contractor may have acquired or possessed or may hereafter acquire or possess, as a result or on account of, the furnishing by the Contractor of services, labor and material used in connection with the construction under and pursuant to the certain Contract between it and said Owner, bearing date of _____ and pertaining to Said Project, or otherwise; and which said liens or claims or rights to lien may exist under and by virtue of an act of the General Assembly of the State of Illinois entitled "An Act to Revise the Law in Relation to Mechanic's Liens," approved May 18, 1903, as amended and in accordance with Chapter 82, Illinois Revised Statutes, 1976 or subsequent amendments thereto.

The undersigned further hereby acknowledges that the sum of _____

_____ Dollars, constitutes the entire balance due the Contractor from said Owner, for all services, labor and materials furnished and work done by it, upon or for Said Project and/or under said Contract, and that the payment in full to the undersigned for everything furnished and/or done by the Contractor in connection with Said Project, whether under the Contract or otherwise, and will satisfy in full, and will operate to fully and completely release said Owner from any and all claims or demands, of whatever nature, which the undersigned may have or assert against it, arising out of the construction and equipping of Said Project, said Contract, and any and all things done or furnished by the undersigned in connection therewith.

CONTRACTOR

BY _____

TITLE _____

Subscribed and Sworn to before me this _____ day of _____, 20____.

NOTARY PUBLIC

AFFIDAVIT OF PAYMENT TO MATERIAL SUPPLIERS AND SUBCONTRACTORS

STATE OF _____

COUNTY OF _____

_____, being first duly sworn upon oath
deposes and says, that he/she entered into a Contract with the ILLINOIS EASTERN COMMUNITY COLLEGES, known as the Owner, for furnishing of labor, work services, materials, fixtures, and supplies for construction of **Athletic Training Facility** at the following described real estate: **Wabash Valley College**.

That for the purpose of said Contract, the following persons, firms or corporations have been contracted with to furnish, have furnished or prepared, or will furnish or prepare labor, services, materials, fixtures, apparatus, machinery or supplies, or are furnishing and preparing material for said construction; that there are due or to become due to them respectively, the amounts set opposite their names for said labor, services, materials, fixtures, apparatus, machinery and supplies as stated; that there are no other contractors outstanding and there is nothing due or to become due any person, firm, or corporation, for labor, services, materials, fixtures, machinery, apparatus, or supplies, other than as stated herewith.

MATERIAL SUPPLIER AND/OR SUBCONTRACTOR	CONTRACT ITEM	CONTRACT AMOUNT	AMOUNT PAID TO DATE	AMOUNT DUE OR TO BECOME DUE
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CONTRACTOR

Subscribed and sworn to before me, a Notary Public, this _____ day of _____; A.D. 20_____.

NOTARY PUBLIC

CONSENT OF SURETY COMPANY TO FINAL PAYMENT
(To be filed with final request for payment)

PROJECT: ATHLETIC TRAINING FACILITY
WABASH VALLEY COLLEGE
ILLINOIS EASTERN COMMUNITY COLLEGE
2200 COLLEGE DRIVE
MT. CARMEL, WABASH CO., ILLINOIS
HR# 395-3272

TO (Owner): ILLINOIS EASTERN COMMUNITY COLLEGE
233 EAST CHESTNUT STREET
OLNEY, IL, 62450

CONTRACTOR:
(Name, address)

CONTRACT DATE:

BOND NO.:

In accordance with the provisions between Owner and Contractor indicated above, _____

_____, SURETY COMPANY, hereby
approves of final payment to Contractor, and agrees that final payment to Contractor shall not relieve
Surety Company of any of its obligations to Owner, as set forth in Surety Company's bond.

IN WITNESS WHEREOF, Surety Company has hereunto set its hand this _____ day of
_____, 20____.

Attest:

Surety Company

(Seal):

Signature of Authorized Representative

Title

GENERAL CONDITIONS – AIA STIPULATED SUM

1.1 SUMMARY

A. Document Includes:

1. General Conditions.

B. Related Documents:

1. Document 00 52 14 – Agreement Form – AIA Stipulated Sum.
2. Document 00 73 13 – Supplementary Conditions - AIA.

1.2 GENERAL CONDITIONS

- A. AIA Document A201-2007, General Conditions of the Contract for Construction, is the General Conditions of the Contract.

1.3 SUPPLEMENTARY CONDITIONS

- A. Refer to Document 007313 for modifications to General Conditions.

END OF DOCUMENT

SUPPLEMENTARY CONDITIONS - AIA

1.1 SUMMARY

- A. Document Includes:
 - 1. General Conditions.
 - 2. Supplementary Conditions.
- B. Related Documents:
 - 1. Document 00 41 13 – Bid Form – Stipulated Sum
 - 2. Document 00 52 14 – Agreement Form - AIA

1.2 GENERAL CONDITIONS

- A. The General Conditions of the Contract for Construction, AIA Document A201, Sixteenth Edition, 2007, Articles 1 through 15, is a part of this Contract and is incorporated herein as fully as if here set forth. Copies of the General Conditions are on file and may be reviewed at the offices of the Architect, or may be obtained from the American Institute of Architects, St. Louis Chapter, 911 Washington St., #225, St. Louis, Missouri 63101-1203.

1.3 SUPPLEMENTARY CONDITIONS

- A. The following supplements modify, change, delete from or add to the "General Conditions of the Contract for Construction," AIA Document A201, Sixteenth Edition, 2007. Where any Article of the General Conditions is modified or changed or any Paragraph, Subparagraph or Clause thereof is modified, changed or deleted by these supplements, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

1.4 REFERENCE TO DIVISION 01

- A. Where provisions of General Conditions relate to project administrative or work-related requirements of the Contract, and those provisions differ from those specified in Division 01, provisions outlined in Division 01 shall prevail.

1.5 ARTICLE 1: GENERAL PROVISIONS

- A. 1.5.1 In the second line following the word "Specifications" insert the words "and Project Manual,".

- B. 1.6 TRANSMISSION OF DATA IN DIGITAL FORM: Add new subparagraph 1.6.1:

1.6.1 Electronic drawings provided by the Owner or Architect are for informational purposes only and are not intended for any other use. The paper copies provided are a true representation of the completed design and if discrepancies should exist between the paper copy and the electronic copy, the paper copy shall govern.

- C. Delete Subparagraph 1.1.8 its entirety and substitute the following:

1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2. If the Initial Decision Maker is not specifically identified in the Agreement, the responsibilities of the Initial Decision Maker shall default to the Architect.

D. DEFINITIONS: Add Paragraph 1.1.9

1.1.9 PROJECT MANUAL

The Project Manual is the collection of documents which includes the bidding requirements, sample forms and, certain Contract Documents such as the Conditions of the Contract and the Specifications.

1.6 ARTICLE 2: OWNER

A. Delete Section 2.2.1 in its entirety.

B. 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER:

C. Delete Subparagraphs 2.2.3 and 2.2.5 in their entireties and substitute the following:

2.2.3 The Owner shall, at the request of the Contractor, furnish to Contractor any survey or other similar descriptive information of project site that Owner has in his possession. Upon demonstration of need by Contractor for specific additional survey information, Owner shall obtain and furnish such information to Contractor.

2.2.5 Contractor will be furnished, free of charge, 1 copy of Drawings, Specifications, and Project Manual as set forth in Division 1 of the Specifications. Additional copies will be furnished to Contractor at cost of reproduction, postage and handling.

1.7 ARTICLE 3: CONTRACTOR

A. 3.2. REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR: Add Subparagraphs 3.2.5 and 3.2.6:

3.2.5 The Contractor by executing the Contract represents that he has carefully examined the Site of the Work at each location and that he has full knowledge of and fully understands the facilities, site conditions, difficulties and restrictions attending performance of the Work. Contractor further represents that he has taken all required measurements and carefully inspected existing constructions, irregularities and interferences which may affect the Work. No additional compensation will be allowed for conditions increasing Contractor's cost which were not known to or appreciated by him prior to executing the Contract if they could have been discovered by him following the foregoing procedures and thoroughly informing himself of all existing conditions affecting the Work.

3.2.6 Contractor will not, however, be required to excavate, penetrate or demolish any constructions or other work and conditions prior to executing the Contract in order to uncover and/or expose concealed conditions that affect the Work. If, during course of construction, Contractor uncovers conditions that affect the work that could not have been known and understood by the above described careful examination of conditions affecting the Work, he shall promptly notify the

Architect, in writing, who will determine if claims for additional costs or extensions of time are justified. If such claims are found to be justified, Contract will be modified in accordance with Article 7 of the General Conditions.

- B. 3.4. LABOR AND MATERIALS: Delete Paragraph 3.4. in its entirety. Refer to Specification Section 01 10 00, Summary, for provisions on this subject. References to Paragraph 3.4 elsewhere in the Contract Documents shall read as referring to Section 01 10 00 of the Specifications.
- C. 3.6. TAXES: Delete Paragraph 3.6 in its entirety. Refer to Specification Section 01 10 00, Summary, for provisions on this subject. References to Paragraph 3.6 elsewhere in the Contract Documents shall read as referring to Section 01 10 00 of the Specifications.
- D. 3.7 PERMITS, FEES AND NOTICES: Delete Paragraph 3.7 in its entirety. Refer to Specification Section 01 10 00, Summary, for provisions on this subject. References to Paragraph 3.7 elsewhere in the Contract Documents shall read as referring to Section 01 10 00 of the Specifications.
- E. 3.8 ALLOWANCES: Delete Paragraph 3.8 in its entirety.
- F. 3.11 DOCUMENTS AND SAMPLES AT THE SITE: Delete Paragraph 3.11 in its entirety.
- G. 3.13 USE OF SITE: Delete Paragraph 3.13 in its entirety. Refer to Specification Section 01 10 00, Summary, for provisions on this subject. References to Paragraph 3.13 elsewhere in the Contract Documents shall read as referring to Section 01 10 00 of the Specifications.
- H. 3.15 CLEANING UP: Delete Paragraph 3.15 in its entirety. Refer to Specification Section 01 70 00, Execution and Closeout Requirements, for provisions on this subject. References to Paragraph 3.15 elsewhere in the Contract Documents shall read as referring to Section 01 70 00 of the Specifications.
- I. 3.18.1 INDEMNIFICATION: Insert the word “defend” between the word “indemnify” and phrase “and hold harmless” in the first sentence. Also insert the phrase “or intentional misconduct” between the phrase “negligent acts or omissions” and the words “of the Contractor”, in the middle of this section.

1.8 ARTICLE 4: ARCHITECT

- A. 4.1 GENERAL: Delete Subparagraph 4.1.1 in its entirety and substitute the following:

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

1.9 ARTICLE 5: SUBCONTRACTORS

A. 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK: Add new Subparagraph 5.2.1.1.:

5.2.1.1. Within ten (10) days of notification of acceptance of his proposal, Contractor shall submit the names of those to whom he intends to award a Subcontract.

1.10 ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

A. 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS: Delete Subparagraph 6.1.3 in its entirety and substitute the following:

6.1.3 General Contractor shall have responsibility of coordinating efforts of all contractors and to maintain overall direction of job progress. Each Contractor shall coordinate operational methods with other contractors and encourage communications among all trades. All Contractors shall make other contractors aware of any problems, delays in materials shipments or lack of work force, and assist other contractors in maintaining job momentum and direction of overall project.

1.11 ARTICLE 8: TIME

A. Add new paragraph 8.3.2 as follows:

8.3.2 Notwithstanding the foregoing or any other provision to the contrary in the Contract, in the event of any delay to the Work caused by weather-related matters or any other event of force majeure or otherwise outside the reasonable control of Owner and Contractor, an extension of the Contract Time shall be the Contractor's sole remedy (which extension shall be subject to the terms of Article 15 below) and the Contract Sum shall not be increased.

1.12 ARTICLE 9: PAYMENTS AND COMPLETION

A. 9.2 SCHEDULE OF VALUES: Add new Paragraph 9.2:

9.2 SCHEDULE OF VALUES: Delete Paragraph 9.2 in its entirety. Refer to Specification Section 01 20 00, Price and Payment Procedures, for provisions on this subject. References to Paragraph 9.2 elsewhere in the Contract Documents shall read as referring to Section 01 20 00 of the Specifications.

B. 9.3 APPLICATIONS FOR PAYMENT: Add new Subparagraph 9.3.1.3

9.3.1.3.: Until Substantial Completion, the Owner will pay 90 percent of the amount due Contractor on account of approved progress payments.

1.13 ARTICLE 11: INSURANCE AND BONDS

A. 11.1.1 In the first line following the word "maintain," insert the words "in a company or companies licensed to do business in the state in which the project is located and rated 'A' or better by A.M. Best Co.". The school district shall be named additional insured for Liability and Automobile Insurance.

B. Add new Subparagraph 11.1.1.9:

11.1.1.9 General Liability Insurance shall be comprehensive, on occurrence, and shall include:

- Premises and Operations.
- Independent Contractors.
- Products and Completed Operations.
- Broad Form Property Damage.
- Personal Injury.
- Explosion, Collapse and Underground damage where the hazard exists.
- Contractual liability.

C. Add the following Sub-Subparagraphs to Subparagraph 11.1.2:

11.1.2.1 The insurance required by Subparagraph 11.1.1 shall be on a project specific basis, shall name Illinois Eastern Community Colleges as an additional insured as primary and non-contributory to any other insurance available, and written for not less than the following, or greater if required by law:

1. Worker's Compensation:

- a. State: Statutory Limits, with Waiver of Subrogation.
- b. Applicable Federal: Statutory Limits, with Waiver of Subrogation
- c. Employer's Liability: \$500,000 Limits, with Waiver of Subrogation

2. Comprehensive General Liability: Limits, with Waiver of Subrogation

a. Bodily Injury:

\$1,000,000 Combined Single Limit

b. Property Damage:

\$1,000,000 Combined Singled Limit

Limit Coverage for bodily injury and property damage per occurrence and in the same aggregate limit will be accepted in lieu of the separate limits specified above.

3. Personal Injury:

\$ 1,000,000 Combined single limit including owned non-owned, and hired motor vehicle.

4. Comprehensive Automobile Liability:

a. Bodily Injury:

\$1,000,000 Combined single limit including owned,

non-owned, and hired motor vehicle.

b. Property Damage:

\$1,000,000 Combined single limit including owned, non-owned, and hired motor vehicle

c. \$1,000,000 Combined Single

Limit coverage for bodily injury and property damage per occurrence and in the same aggregate limit will be accepted in lieu of the separate limits specified above.

11.1.2.2 Umbrella Form Liability Coverage:

An Umbrella Form Liability coverage to not less than \$2,000,000 for any one occurrence and subject to the same aggregate over the Employer's Liability, Comprehensive General Liability, and Comprehensive Automobile Liability coverage is required.

D. Add the following Subparagraph 11.1.3.1:

11.1.3.1 Contractor shall furnish one copy each of Certificates of Insurance herein required for each copy of the Agreement which shall specifically set forth evidence of all coverage required by Paragraph 11.1. The Certificate of Insurance is to be accompanied by AIA Document G715TM-1997 (Supplemental Attachment for ACORD Certificate of Insurance 25-S). Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits. The Contractor shall furnish to the Owner notice of any policy cancellation at least 30 days (10 days for non payment of premiums) prior to the effective date of cancellation. The Contractor shall submit copies of subcontractor's Certificates of Insurance prior to the beginning of work.

E. Add the following Subparagraph 11.1.4.1:

11.1.4.1 The Owner, Architect, Contractors and Sub-Contractors shall be named as additional insureds on ISO form 20331001 by endorsement for the purpose of coverage only with no liability for premium payments. All policies and coverages shall include a waiver of subrogation in favor of the Owner.

F. 11.3. PROPERTY INSURANCE: Delete Subparagraph 11.3.1 in its entirety and substitute the following:

11.3.1: The General Contractor shall be responsible to maintain property (builder's risk) insurance upon the completed value of all work at the site under this contract to the full insurable value thereof. This insurance shall include the interests of the Owner, the General Contractor, Subcontractors, and Sub-subcontractors in the work and as their interests may appear in the work, and shall be an all-risk type policy, including theft, subject to the exclusions generally accepted in the insurance industry. This coverage is not intended to, and shall not, provide coverage for tools, equipment, scaffolding, forms, or other devices used by the Contractors or Subcontractors in performing work under this contract.

11.3.1.2 Delete this Paragraph in its entirety.

G. Delete Subparagraphs 11.3.1.3 in its entirety and substitute the following:

11.3.1.3 If the property insurance requires deductibles, the Contractor shall pay costs not covered because of such deductibles.

1.14 ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

A. Add new paragraph 12.2.6 as follows:

12.2.6 As part of its Work, the Contractor shall perform a one-year warranty inspection with the Architect and Owner within one year of Substantial Completion to ascertain any defects or failures in Contractor's Work.

If any defects, deficiencies, or failures or noted the Contractor shall promptly remedy such defect, deficiency or failure. All obligations are in addition to any other warranties to be provided as part of its Work.

1.15 ARTICLE 13: MISCELLANEOUS PROVISIONS

A. Revise ARTICLE 13.1 to read: the contract shall be governed by Illinois law.

B. Add new paragraph 13.8 as follows:

13.8 REFERENCED STANDARDS

13.8.1 No provision of any referenced standard specification, manual or code; whether or not specifically incorporated by reference in the Contract Documents; shall be effective to change the duties and responsibilities of Owner, Contractor or Architect, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Architect, or any of Architect's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Articles 1 through 15.

C. Delete Section 13.6 INTEREST.

D. Delete Section 13.7 TIME LIMITS ON CLAIMS

E. Add New Section which reads:

In the event the Owner files a court proceeding to enforce the terms or provisions of this Agreement or to recover damages from the Contractor and/or its Surety for breach of the Agreement, the Owner shall be entitled to recover its reasonable attorneys' fees and/or legal expenses in the event the Owner is the prevailing party. In any court proceeding brought by one party hereto against the other to enforce or interpret the terms of the Agreement or to resolve any dispute concerning any party of the services or Work, the action shall be filed in the Circuit Court of Jackson County, Illinois.

1.16 ARTICLE 15: CLAIMS AND DISPUTES

A. Add at the end of Section 15.1.4. CLAIMS FOR ADDITIONAL COSTS.

"It is understood and agreed that Contractor has fully and adequately investigated market prices for labor and supplies and will be taking the risk for increases in costs of materials and labor price increases and that the general conditions included in the

Contract Sum have taken this into account. There shall be no increase in the Contract Sum due to an increase in either cost nor shall there be any increase in general conditions nor Contract Sum due to an increase in Contract Time due to weather related delays, although there may be an agreement as to an increase in Contract Time as set forth in Section 15.1.5 below”

B. Add at the end of Section 15.1.5.2

“Contractor shall not be entitled to an increase in the Contract Sum for any reason related to or arising out of adverse weather conditions. In addition, Contractor shall not be entitled to an extension of time based on adverse weather conditions unless Contractor establishes to the reasonable satisfaction of the Initial Decision Maker that such adverse weather was abnormal for the period in which the Work was performed, based upon NOAA data of the location of the Work.”

C. Delete Section 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

D. Delete Sections 15.2.6, 15.2.6.1, and 15.2.8.

E. Delete Section 15.3 MEDIATION in its entirety.

F. Delete Section 15.4 ARBITRATION in its entirety.

G. Delete Section 15.4.4. CONSOLIDATION OR JOINDER in its entirety.

END OF SECTION

ARTICLE 25: PREVAILING RATE OF WAGES

25.1 Pursuant to Illinois Compiled Statutes 820 ILCS 130/0.01 et seq., these specifications list on the following pages, the Illinois Department of Labor prevailing rate of wages for the county where the contract is being performed and for each craft or type of worker needed to execute the contract.

END OF SECTION

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Contract description.
- B. Contractor's use of site and premises.
- C. Owner occupancy.
- D. Specification Conventions.
- E. Contractor's Duties.

1.2 CONTRACT DESCRIPTION

- A. Work of the Project includes:

Construction of a new 8450 square foot athletic training facility for Wabash Valley College. The construction will consist of a pre-engineered metal building with concrete foundation containing; a training area for soccer and baseball featuring an enclosed athletic netting system with synthetic turf floor, three locker rooms, a concession area with casework, two public restrooms, a second-floor storage area, exterior barrier netting, and a parking area. The work includes, but is not limited to architectural, structural, civil, electrical, mechanical, and plumbing work.

Alternate No. 1: Painting of angled stripes on exterior panels, east and west elevations. Approximately 220 square feet. Final color selection and specific layout of design to be coordinated with owner.

- B. Construction of a new athletic training facility for Wabash Valley College.
- C. Perform Work of the Contract under fixed cost contract with Owner in accordance with Conditions of Contract.

1.3 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limit use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Owner.
 - 3. Use of site and premises by the public.

1.4 OWNER OCCUPANCY

- A. The Owner will occupy the premises during construction for the conduct of normal operations.

- B. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

1.5 SPECIFICATION CONVENTIONS

- A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

1.6 CONTRACTOR'S DUTIES

- A. Except as specifically noted, Contractor shall provide and pay for:
 - 1. All labor, materials, and equipment used for construction of and/or incorporated into the project.
 - 2. All tools, construction equipment and machinery.
 - 3. Required building permits, and all inspection fees by governmental authorities.
 - 4. Other facilities and services necessary for proper execution and complete of work.
- B. Owner is exempt from sales tax on product permanently incorporated in work.
 - 1. Obtain sales tax exemption certificate number from Owner.
 - 2. Place exemption certificate number on invoices for materials incorporated in work.
 - 3. Upon completion of work, file with Owner a notarized statement that all purchases made under exemption certificate were entitled to be exempt and furnish copies of invoice to Owner.
 - 4. Pay legally assessed penalties for improper use of exemption certificate number.
- C. Comply with codes, ordinances, rules, regulations, orders, and other legal requirements of public authorities which bear on performance of work.
- D. Promptly submit written notice to Architect/Engineer of observed variance of contract documents from legal requirements.
 - 1. It is not the Contractor's responsibility to make certain that drawings and specifications comply with codes and regulations.
 - a. Appropriate modifications to contract documents will account for/reflect necessary changes.
 - b. Assume responsibility for work known to be contrary to such requirements if written notice is not provided by the Contractor to the Architect.
- E. Enforce strict discipline and good order among employees.
- F. Do not unreasonably encumber site with materials or equipment.
- G. Do not load structure with weight that will endanger structure.
- H. Assume full responsibility for protection and safe-keeping of products stored on premises.
- I. Move any stored products which interfere with operations of Owner or other Contractors.
- J. Obtain and pay for use of additional storage or work areas needed for operations.

- K. The Owner, IECC, maintains a Tobacco-free/Smoke-Free Campus at each of its locations. See internet location given below for full policy statement:
- <https://iecc.edu/smokefree#:~:text=IECC%20Policy%20on%20Tobacco%20and%20Smoking&text=As%20of%20July%201%2C%202015,District%20owned%20or%20leased%20vehicles..>
- L. All members of work crews must remain fully clothed and refrain from using obscene or profane language.
- M. If a site visit outside of the scheduled pre-bid meeting is desired prior to submitting a bid, it shall be coordinated through Ernest Majors Wabash Valley College Operations & Maintenance Leader, to determine an acceptable time and date. Mr. Majors can be reached at (618) 240-3525 or majorse@iecc.edu to schedule a visit.
- N. Contractor shall maintain building free from entrance of water at all times during construction.
- O. Contractor shall furnish, erect and maintain temporary ladders, ramps, or hoists as may be required for performance of his work.
1. All such equipment shall be substantially designed, constructed, and maintained in accordance with applicable federal, state, and local laws, ordinances, and regulations, and shall be promptly removed when no longer needed.
- P. Contractor shall design, furnish, erect, maintain, and move all ladders and scaffolding required for this work.
1. All ladders and scaffolding shall be designed, constructed, and maintained in accordance with applicable federal, state, and local law, ordinances, and regulations, and shall be promptly removed when no longer needed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Schedule of values.
- B. Applications for payment.
- C. Change procedures.
- D. Defect assessment.

1.2 SCHEDULE OF VALUES

A. REQUIREMENTS INCLUDE

- 1. Contractor:
 - a. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702. Contractor's standard form or electronic media printout will be considered, if it is similar in format to AIA Form G703.
 - b. Upon request Contractor to provide to A/E, any substantiating information provided to them by Subcontractors, including subcontractors schedule of values.
- 2. Subcontractors:
 - a. Submit Schedule of Values to Contractor within 15 days after date established in Notice to Proceed.
 - b. Support values given with data to substantiate their correctness.
 - c. Submit quantities of designated materials.
 - d. Use Schedule of Values as only basis for application for payment.
- 3. Payment for materials stored on or off site will be limited to those materials listed in Schedule of Values.
 - a. All materials to be accompanied by Certificate of Insurance naming the project and owner.
 - b. All materials to be accompanied by photo documentation with labelling designating the subcontractor in possession of the materials, the project that it belongs to, and the identity of the materials.

B. FORM OF SUBMITTAL

- 1. The schedule of values shall be prepared in such manner that each major item of Work and each subcontracted item of Work is shown as a separate item (Materials and Labor).
- 2. Contractor shall use the the specification index as a basis of example and format for listing and itemizing costs of work.

C. PREPARATION

- 1. Itemize separate line item cost for each of the following cost items:
 - a. Itemize separate line items for total installed costs: material and labor shall be separate line items. For each line item indicate quantity, unit of measure, cost per unit, and total less general profit, overhead and bond.
 - b. Overhead and Profit.

- c. Bonds.
 - d. Insurance
 - e. Mobilization
 - f. Construction Administration Fees
 - g. General requirements:
 - 1) Break down general requirements to temporary facilities. Show initial installation and maintenance and fuel consumption.
 - 2. Itemize separate line item cost for work specified in each section of the specifications. Identify work of:
 - a. Contractor's own labor forces.
 - b. All subcontractors.
 - c. All major suppliers of products or equipment.
 - 3. Break down installed costs into:
 - a. Delivered cost of product, with taxes paid.
 - b. Labor cost, excluding overhead and profit.
 - 4. For each line item that has installed value of more than \$1,000/00, break down costs to list major products or operations under each item.
 - a. Contractor, subcontractor or supplier.
 - b. Specification section number.
 - c. Description of work or material.
 - d. Quantity.
 - e. Unit price.
 - f. Scheduled value.
 - g. % of contract.
 - 5. Make sum of total costs of all items listed in Schedule equal to total contract sum.
 - 6. Identify work performed by MBE/FBE subcontractors and suppliers.
- D. REVIEW AND RESUBMITTAL
- 1. After review by Architect/Engineer, revise and resubmit Schedule as directed.
 - 2. Follow original submittal procedure.
- E. UPDATE
- 1. Update Schedule of Values when:
 - a. Directed by Architect/Engineer.
 - b. To list approved Change Orders, with each Application for Payment.
 - c. Change of subcontractor or supplier occurs.
 - d. Change of product or equipment occurs.

1.3 APPLICATIONS FOR PAYMENT

- A. Submit application for payment to Architect/Engineer for processing no later than 10 days prior to date established for progress payment meeting.
- B. PREPARATION OF APPLICATION FOR EACH PROGRESS PAYMENT
 - 1. Application form:
 - a. Fill in required information, including that for orders executed prior to date of submittal of application.
 - b. Execute certification with signature of a responsible officer of contracting firm.
 - c. Fill in total list of all scheduled component items of work, with item number and scheduled dollar value for each item.

- d. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored.
 - e. List each change order executed prior to date of submission at end of continuation sheets.
 - 1) List by change order number and description as for an original component item or work.
2. Each application for progress payment shall be accompanied by the following supporting documents.
- a. Certification.
 - b. Periodic Estimate for Partial Payments
 - c. Schedule of Change of Orders.
 - d. Schedule of Materials Stored.
 - e. Summary of Materials Stored.
 - f. Construction Progress Schedule.
 - g. Notarized Final and Partial Waivers of Lien.
- C. MATERIAL OR EQUIPMENT NOT INCORPORATED IN THE WORK
1. Progress payments will be made for materials and equipment not incorporated in the Work provided that:
- a. Such materials and equipment have been delivered to and suitably stored at site or some other location approved in writing by Owner and Architect/Engineer. All such materials stored off-site shall be marked or tagged with identification of project to which they are assigned.
 - b. Contractor submits evidence of title to such materials and equipment.
 - c. Care and custody of such materials and equipment and all costs incurred for movement and storage shall be responsibility of Contractor.
 - d. Such materials and equipment are suitably insured by Contractor. Contractor shall submit a certificate of insurance showing the owner as an additional insured and showing amount of insurance coverage.
- D. SUBSTANTIATING DATA FOR PROGRESS PAYMENTS
1. When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
- a. Partial release of liens from major subcontractors and vendors
 - b. Record documents for review by Owner which will be returned to Contractor.
 - c. Affidavits attesting to off-site stored products.
 - d. Construction progress schedules, revised and current.
- E. Submit updated construction schedule with each Application for Payment.
- F. Submit with transmittal letter as specified for Submittals in Section 01 33 00.
- H. Application for Progress Payment No. 1 shall be accompanied by a notarized statement on Contractor's letterhead as follows:
- 1. I certify that the funds requested for the accompanying Pay Request No. 1 will be used to pay all just and lawful bills against the undersigned and his subcontractors for labor, material and equipment employed in the performance of the work. I further certify that such bills will be paid no later than ten (10) calendar days from date of receipt of the Owner's disbursement.
 - 2. Execute statement with signature of a responsible officer of contracting firm.
- I. Each subsequent application for progress payment shall be accompanied by the following supporting documents:

1. Partial or final waivers of lien in monetary amount from Contractor, each material supplier and/or subcontractor reflecting amounts incorporated into preceding request for progress payment.
 2. A notarized Affidavit of Payment to Material Suppliers and Subcontractors.
 - a. Affidavit shall be submitted in exact text as exhibit furnished by Architect/Engineers, signed by Contractor or Subcontractor.
 - b. Include unit item, actual amount of contract without overhead or profit, amount paid to date, and amount to become due (balance of account).
- K. Refer to Section 01 70 00 for submittal requirements for application for final payment and related closeout procedures.

1.4 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions in writing.
- C. The Architect/Engineer may issue a Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with stipulation of overtime work required and/or the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within a reasonable time period.
- D. Contractor may propose changes by submitting a request for change to Architect/Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 01 60 00.
- E. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Architect/Engineer.
- F. Architect/Engineer may issue directive, on HR Change Order form signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
- G. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Architect/Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
- H. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

- I. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.
- J. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
- K. Correlation Of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - 3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
- B. If, in the opinion of the Architect/Engineer, it is not practical to remove and replace the Work, the Architect/Engineer will direct appropriate remedy or adjust payment.
- C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer.
- D. Defective Work will be partially repaired to instructions of Architect/Engineer and unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer.
- E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.
- F. Authority of Architect/Engineer to assess defects and identify payment adjustments is final.
- G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected products.

PART 2 EXECUTION

Not Used.

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination and project conditions.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Cutting and patching.
- E. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
- B. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

- A. Architect/Engineer will schedule meeting after Notice of Award.
- B. Attendance Required: Owner, Architect/Engineer, and Contractor.
- C. Agenda:
 - 1. Submission of executed bonds and insurance certificates.
 - 2. Distribution of Contract Documents.

3. Submission of list of products, list of subcontractors, schedule of values, and progress schedule.
 4. Designation of personnel representing parties in Contract, and Architect/Engineer.
 5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 6. Scheduling.
 7. Use of premises by Owner and Contractor.
 8. Owner's requirements and occupancy.
 9. Construction facilities and controls.
 10. Temporary utilities.
 11. Security and housekeeping procedures.
 12. Schedules.
 13. Application for payment procedures.
 14. Procedures for testing.
 15. Procedures for maintaining record documents.
 16. Requirements for start-up of equipment.
 17. Inspection and acceptance of equipment put into service during construction period.
- D. Architect/Engineer will record minutes and distribute copies with reasonable promptness after meeting to participants, with two copies to Architect/Engineer, Owner, and those affected by decisions made.

1.4 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Architect/Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.
- D. Agenda:
 1. Review minutes of previous meetings.
 2. Review of Work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems impeding planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of off-site fabrication and delivery schedules.
 7. Maintenance of progress schedule.
 8. Corrective measures to regain projected schedules.
 9. Planned progress during succeeding work period.
 10. Coordination of projected progress.
 11. Maintenance of quality and work standards.
 12. Effect of proposed changes on progress schedule and coordination.
 13. Other business relating to Work.
- E. Architect/Engineer will record minutes and distribute copies with reasonable promptness after meeting to participants, with two copies to Architect/Engineer, Owner, and those affected by decisions made.

1.5 PRE-INSTALLATION MEETINGS

- A. When required in individual specification sections, Contractor to convene pre-installation meetings at Project site prior to commencing work of specific section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific section.
- C. Notify Architect/Engineer five business days in advance of meeting date.
- D. Prepare agenda and preside at meeting
 - 1. Review conditions of installation, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Entity responsible for conducting meeting will record significant discussions. Distribute minutes of the meeting to each party present and to other parties requiring information, including Architect/Engineer and Owner, within five business days of meeting.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products in accordance with requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material, to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

3.2 SPECIAL PROCEDURES

- A. Materials: As specified in product sections; match existing with new products for patching and extending work.
- B. Employ skilled and experienced installer to perform alteration work.
- C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- E. Remove debris and abandoned items from area and from concealed spaces.
- F. Prepare surface and remove surface finishes to permit installation of new work and finishes.
- G. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original or specified condition.
- I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with neat transition to adjacent finishes.
- J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- K. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.
- L. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition; to Architect/Engineer for review.
- M. Trim existing doors to clear new floor finish. Refinish trim to original or specified condition.
- N. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

- O. Finish surfaces as specified in individual product sections.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Product data.
- D. Shop drawings.
- E. Samples.
- F. Test reports.
- G. Certificates.
- H. Manufacturer's instructions.

1.2 SUBMITTAL PROCEDURES

- A. **Transmit each submittal with shop drawing submittal form found at the end of this section. A copy of the submittal form must be attached to each copy of the submittal; if not, the submittal will be rejected and returned to the Contractor.**
- B. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
- C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
- D. Schedule submittals to expedite Project, and deliver to Architect/Engineer at business address. Coordinate submission of related items.
- E. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- F. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.
- G. Allow space on submittals for Contractor and Architect/Engineer review stamps.
- H. When revised for resubmission, identify changes made since previous submission.
- I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

J. Submittals not requested will not be recognized or processed.

1.3 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial schedules within 15 days after date established in Notice to Proceed. After review, resubmit required revised data within ten days.
- B. Submit revised Progress Schedules with each Application for Payment.
- C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.
- D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.
- E. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.
- F. Indicate estimated percentage of completion for each item of Work at each submission.
- G. Submit separate schedule of submittal dates for shop drawings, product data, and samples and dates reviewed submittals will be required from Architect/Engineer. Indicate decision dates for selection of finishes.
- H. Revisions To Schedules:
 - 1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
 - 2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
 - 3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate contractors.

1.4 PRODUCT DATA

- A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Submit number of copies Contractor requires, plus 3 copies Architect/Engineer will retain.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00.

1.5 SHOP DRAWINGS

- A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Shop Drawings can be submitted electronically for review. Electronic submittal should be e-mailed to the Project Construction Manager and will be e-mailed back to the contractor once reviewed.
- D. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01 70 00.

1.6 SAMPLES

- A. Samples: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Samples For Selection as Specified in Product Sections:
 - 1. Submit to Architect/Engineer for aesthetic, color, or finish selection.
 - 2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Architect/Engineer selection.
- C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- D. Include identification on each sample, with full Project information.
- E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain one sample.
- F. Reviewed samples which may be used in the Work are indicated in individual specification sections.
- G. Samples will not be used for testing purposes unless specifically stated in specification section.
- H. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01 70 00.

1.7 TEST REPORTS

- A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.
- B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.9 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION



SHOP DRAWING SUBMITTAL

PROJECT: Athletic Training Facility DATE: _____
Wabash Valley College
Illinois Eastern Community Colleges

A/E PROJECT NO: HR #395-3272

CONTRACTOR: _____

PRESENTED BY: _____
(Subcontractor/Supplier) Company Name

Address

Phone/Fax

Contact Person

ITEM: _____

SPEC SECTION: _____

By approving and submitting these shop drawings, product data and samples, we represent that we have determined and verified all materials, field measurements and field construction criteria related thereto, or will do so, and that we have checked and coordinated information contained within submittal with requirements of the work and contract documents.

Contractor's Signature

Date

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality control and control of installation.
- B. Tolerances
- C. References.
- D. Testing and inspection services.
- E. Examination.
- F. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 TESTING AND INSPECTION SERVICES

- A. Requirements include:
 - 1. Contractor will employ and pay for testing laboratory to perform specified services.
 - 2. Employment of testing laboratory will in no way relieve Contractor's obligations to perform work in accord with the Contract.
- B. Laboratory Duties – Limits of Authority
 - 1. Cooperate with Architect/Engineer and Contractor; provide qualified personnel promptly on notice.
 - 2. Perform specified inspections, sampling and testing of materials and construction methods:
 - a. Comply with specified standards; ASTM, and other recognized authorities.
 - b. Ascertain compliance with contract requirements.
 - c. Obtain written acknowledgement of each inspection, sampling and test made from Contractor whose work is being tested or from his superintendent.
 - 3. Promptly notify Architect/Engineer and Contractor of irregularities or deficiencies of work which are observed during performance of services.
 - 4. Promptly submit three copies of reports of inspections and tests to Architect/Engineer, including:
 - a. Date issued.
 - b. Project title and number.
 - c. Testing laboratory name and address.
 - d. Name and signature of inspector.
 - e. Date of inspection and sampling.
 - f. Record of temperature and weather.
 - g. Date of test.
 - h. Identification of product and specification section.
 - i. Location of project.
 - j. Type of inspection or test.
 - k. Observations regarding compliance with contract documents.
 - 5. Perform additional services ordered by Architect/Engineer.
 - 6. Laboratory is not authorized to:
 - a. Release, revoke, alter or enlarge on, contract requirements.

- b. Approve or accept any portion of work.
 - c. Perform any duties of the Contractor.
- C. Contractor's Responsibilities
- 1. Furnish product mix design to meet or exceed contract requirements.
 - 2. Cooperate with laboratory personnel; provide access to work and to manufacturer's operations.
 - a. Monitor, or direct superintendent to monitor each inspection, sampling and test.
 - b. Provide laboratory with written acknowledgement of each inspection, sampling or test.
 - c. Within 24 hours, notify Architect/Engineer in writing of reasons for not accepting laboratory field procedures.
 - 3. Provide to laboratory preliminary representative samples of materials to be tested, in specified quantities.
 - 4. Furnish copies of mill test reports.
 - 5. Furnish copies of mix tickets, where applicable.
 - 6. Furnish verification of compliance with contract requirements for materials and equipment.
 - 7. Furnish labor and facilities:
 - a. To provide access to work to be tested.
 - b. To obtain and handle samples at site.
 - c. To facilitate inspections and test.
 - d. For laboratory's exclusive use for storage and curing of test samples.
 - 8. Notify laboratory sufficiently in advance of operations to allow for its assignment of personnel and scheduling of tests.
 - 9. Correct work which is defective or which fails to conform to the contract documents in accordance with the General Conditions. Corrective work shall not delay the project schedule or the work of other contractors.
 - 10. Pay all costs of retesting when test results indicate non-compliance with contract requirements.
 - 11. Patch all surfaces and areas disturbed by testing operations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary water service.
 - 3. Temporary sanitary facilities.
- B. Construction Facilities:
 - 1. Vehicular access.
 - 2. Parking.
 - 3. Progress cleaning and waste removal.
- C. Temporary Controls:
 - 1. Dust control.
 - 2. Noise control.
 - 3. Pollution control.
- D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

- A. Owner will pay cost of energy used. Exercise measures to conserve energy. Utilize Owner's existing power service.

1.3 TEMPORARY WATER SERVICE

- A. Owner will pay cost of temporary water. Exercise measures to conserve energy. Utilize Owner's existing water system, extend and supplement with temporary devices as needed to maintain specified conditions for construction operations.

1.4 TEMPORARY SANITARY FACILITIES

- A. Existing designated facilities may be used during construction operations. Maintain daily in clean and sanitary condition.
- B. At end of construction, return existing facilities used for construction operations to same or better condition as original condition.

1.5 VEHICULAR ACCESS

- A. Location approved by Owner.
- B. Provide unimpeded access for emergency vehicles. Maintain **20 feet** wide driveways with turning space between and around combustible materials.
- C. Provide and maintain access to fire hydrants free of obstructions.

D. Use designated existing on-site roads for construction traffic.

1.6 PARKING

A. Use of designated areas of existing parking facilities used by construction personnel is permitted.

1.7 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.8 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations.

1.9 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.10 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Clean and repair damage caused by installation or use of temporary work.

B. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Product substitution procedures.
- F. Equipment electrical characteristics and components.

1.2 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

- E. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specify time restrictions for submitting requests for Substitutions during bidding period to requirements specified in this section.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 - 3. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.
- B. Cord and Plug: Furnish minimum 6-foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01 70 00

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Protecting installed construction.
- D. Project record documents.
- E. Operation and maintenance data.
- F. Manual for materials and finishes.
- G. Product warranties and product bonds.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
- B. Provide submittals to Architect/Engineer required by authorities having jurisdiction.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy all of building as specified in Section 01 10 00.

1.3 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
- D. Clean filters of operating equipment.
- E. Clean debris from drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.5 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Details not on original Contract drawings.
- G. Submit documents to Architect/Engineer with claim for final Application for Payment.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, capacity expansion binders with durable plastic covers.
- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Certificates.
 - c. Photocopies of warranties and bonds.

1.7 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes in final form within 10 days after final inspection.
- E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.

- F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- H. Additional Requirements: As specified in individual product specification sections.
- I. Include listing in Table of Contents for design data, with tabbed flysheet and space for insertion of data.

1.8 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include Table of Contents and assemble in binder with durable plastic cover.
- F. Submit prior to final Application for Payment.
- G. Time Of Submittals:
 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
 2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Insulating concrete forms.
3. Shoring, bracing, and anchoring.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for materials supported by formwork.

1.2 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Forms for cylindrical columns.
4. Pan-type forms.
5. Void forms.
6. Insulating concrete forms.
7. Form ties.
8. Waterstops.
9. Form-release agent.

- B. Shop Drawings: Design of formwork, shoring, and reshoring and its removal is the sole responsibility of the Contractor. Shop drawings for each shall be prepared by, signed, and sealed by a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. Design shall conform to ACI 117 (117M), ACI 301 (301M), ACI 318 (318M), and ACI 347 (347M).
2. For exposed vertical concrete walls, indicate dimensions and form tie locations.
3. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 (301M).
 - a. Location of construction joints is subject to approval of the Engineer.
4. Indicate location of waterstops.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
6. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

1.4 INFORMATIONAL SUBMITTALS

- A. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC308.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency acceptable to authorities having jurisdiction and qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

- a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).
- B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301 (301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - 1) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
 - 2) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
 - 3) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation, with straight end forms.

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

2.3 INSULATING CONCRETE FORMS

A. Insulating Concrete Forms: Concrete-forming system complying with ASTM E2634, consisting of two panels of insulation connected with cross ties.

1. Insulation: ASTM C578, Type II, expanded polystyrene.
 - a. Thickness: Not less than 2-1/2 inches each face.
 - b. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame Spread: 25 or less.
 - 2) Smoke Developed Index: 450 or less.

2. Cross Ties: Polypropylene, with integral reinforcement supports, designed to allow passage of concrete during placement.
3. Core Thickness: As required by form designer.

2.4 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
 1. Profile: Flat dumbbell without center bulb, Ribbed with center bulb, or Ribbed without center bulb.
 2. Dimensions: Sized to suit joints where required, non-tapered.
- B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.
 1. Profile: Flat dumbbell without center bulb, Ribbed with center bulb, or Ribbed without center bulb.
 2. Dimensions: Sized to suit joints where required, non-tapered.
- C. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
 1. Profile: Flat dumbbell without center bulb, Ribbed with center bulb, or Ribbed without center bulb.
 2. Dimensions: Sized to suit joints where required, non-tapered.
- D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
- E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.5 RELATED MATERIALS

- A. Expansion Joint Filler: Asphalt impregnated, pre-molded fiberboard expansion joint filler conforming to ASTM D1751. 1/2-inch thick by full thickness of slab or joint, unless indicated otherwise on Drawings.
- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301 (301M).
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (117M) and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes (and, if applicable, Section 033300 "Architectural Concrete").
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 3. Place joints perpendicular to main reinforcement.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 5. Space vertical joints in walls at a maximum 25'-0" apart.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
 - 5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 - 4. Secure waterstops in correct position at 12 inches on center.
 - 5. Clean waterstops immediately prior to placement of concrete.
 - 6. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Protect exposed waterstops during progress of the Work.

3.4 INSTALLATION OF INSULATING CONCRETE FORMS

- A. Comply with ACI 301 (301M) and manufacturer's instructions.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (117M).
- C. Install forms in running bond pattern.
 - 1. Align joints.
 - 2. Align furring strips.
- D. Construct forms tight to prevent loss of concrete mortar.

- E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.5 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed at an appropriate time in accordance with ACI 347. Concrete must be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

SECTION 03 20 00

CONCRETE REINFORCING

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the Project Site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Epoxy repair coating.
 - 3. Mechanical splice couplers (if used by the Contractor).
- B. Shop Drawings: Comply with ACI MNL-66:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
 - 3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For testing and inspection agency.
- B. Material Certificates: For each of the following, signed by manufacturers:
 1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
 2. Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- C. Material Test Reports: For the following, from a qualified testing agency:
 1. Steel Reinforcement:
 2. Mechanical splice couplers (if used by the Contractor).
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 1. Store reinforcement to avoid contact with earth.
 2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, Grade 60, deformed.

- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 deformed bars, assembled with clips.
- E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Mechanical Splice Couplers: ACI 318 (ACI 318M) compliant, capable of developing 1.25 times the reinforcing bar's yield strength.
- C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
- D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

2.3 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 and the Contract Drawings.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 - 2. Stagger splices in accordance with ACI 318.
 - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
- G. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.
- H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 - 1. Steel-reinforcement placement.
 - 2. Steel-reinforcement mechanical splice couplers.
 - 3. Formwork, including shape, location, and dimensions for accuracy.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

- B. Related Requirements:

- 1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
 - 2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.3 DEFINITIONS

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

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the Project site.

- 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete materials.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Architect/Engineer.
 - 2. Review the following:

- a. Special inspection and testing and inspecting agency procedures for field quality control.
- b. Construction joints, control joints, isolation joints, and joint-filler strips.
- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- l. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31).
- p. Protection of field cured field test cylinders.
- q. Each type of reinforcement.
- r. Bar supports.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Slag cement.
- 4. Blended hydraulic cement.
- 5. Silica fume.
- 6. Performance-based hydraulic cement
- 7. Aggregates.
- 8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 9. Fiber reinforcement.
- 10. Color pigments
- 11. Vapor retarders.
- 12. Floor and slab treatments.
- 13. Liquid floor treatments.
- 14. Curing materials.
- 15. Joint fillers.
- 16. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.

2. Structural member the mix will be used for.
3. Minimum 28-day compressive strength.
4. Durability exposure class.
5. Maximum w/cm.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Steel-fiber reinforcement content (if applicable).
10. Synthetic micro-fiber content (if applicable).
11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
12. Intended placement method.

C. Concrete Schedule: For each location of each Class of concrete indicated in “Concrete Mixtures” Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

D. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Adhesives.
9. Vapor retarders.
10. Semirigid joint filler.
11. Joint-filler strips.

12. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 1. Portland cement.
 2. Fly ash.
 3. Slag cement.
 4. Blended hydraulic cement.
 5. Silica fume.
 6. Performance-based hydraulic cement.
 7. Aggregates.
 8. Admixtures.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is similarly qualified.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.
 1. Include the following information in each test report.
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94 and ACI 301.

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Notify the Engineer of any methods or admixtures the concrete manufacturer would like to use to combat the effects of cold-weather placement.
6. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Notify the Engineer of any methods or admixtures the concrete manufacturer would like to use to combat the effects of hot-weather placement.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301
2. ACI 117
3. ACI 318
4. ACI 305.1
5. ACI 306.1
6. ACI 308.1

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project. The Project Architect and Engineer must be formally notified if an additional supplier or replacement supplier is used.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150.
2. Fly Ash: ASTM C618.
3. Slag Cement: ASTM C989.
4. Blended Hydraulic Cement: ASTM C595.
5. Silica Fume: ASTM C1240.
6. Performance-Based Hydraulic Cement: ASTM C1157 (Type GU, general use)

C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size:
 - a. 1-1/2 inches for footings and foundation elements exceeding 12" thick.
 - b. 1 inch for slabs and walls.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D

F. Water and Water Used to Make Ice: ASTM C94 and potable

2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, ASTM E 1745, Class A, maximum water-vapor permeance of minimum thickness of 10 mil; type recommended for below grade application. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 NON-SHRINK GROUT

- A. ASTM C 1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agent; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
- D. Curing Paper: Eight-foot-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Floor Slab Protective Covering: Eight-foot-wide cellulose fabric.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, nonload bearing, Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).
- B. Limits on Cementitious Materials: For concrete members with an F3 Exposure Class, limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

2.8 REPAIR MATERIALS

- A. Repair Underlayment or Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Class A: Normal-weight concrete used for Grade-beams, Pedestals, and Column Footings.

Exposure Class(es)	F0
Min. Compressive Strength	4000psi at 28 days
Maximum w/cm ratio	0.48
Slump Limit	5 inches ±1 inch, for mixtures with no water-reducers or prior to water-reducers; 8 inches otherwise
Air Content	3.0 percent, ±1.5 percent
Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.	

- B. Class B: Normal-weight concrete used for Interior Slabs-on-Grade.

Exposure Class(es)	F0
Min. Compressive Strength	4000psi at 28 days
Maximum w/cm ratio	0.5
Slump Limit	5 inches \pm 1 inch, for mixtures with no water-reducers or prior to water-reducers; 8 inches otherwise
Air Content	3.0 percent, \pm 1.5 percent
Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.	

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.
- B. Protection of In-Place Reinforcement Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placement concrete.
- C. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.3 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed concrete: Symmetrically align joints in forms.
- D. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Chamfer exterior corners and edges of permanently exposed concrete.

- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.5 REMOVING AND RESUSING FORMS

- A. Refer to specification Section 031000.

3.6 SHORING AND RESHORING INSTALLATION

- A. Refer to specification Section 031000.

3.7 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

3.8 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 5. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
 2. Use set retarding admixtures during hot weather.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish:
 - 1. When bleed water sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 - 2. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
- C. Trowel Finish:
 - 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 - 2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 3. Do not add water to concrete surface.
 - 4. Do not apply hard-troweled finish to concrete; normal-troweled is the requirement.
 - 5. Apply a trowel finish to surfaces exposed to view.
 - 6. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.
 - 7. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-foot. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thick-set or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 - 1. Coordinate required final finish with Architect before application.
 - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing:
 - 2. Moisture-Retaining-Cover Curing:
 - 3. Curing Compound:
 - 4. Curing and Sealing Compound:

3.13 TOLERANCES

- A. Conform to ACI 117.

3.14 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s).
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of

cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

- A. Special Inspections: Contractor will hire a special inspector to perform field tests and inspections and prepare testing and inspection reports. Contractor must coordinate with this inspector prior to placing any concrete.
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 degrees F and below or 80 degrees F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 - 6. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 - 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 - 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 - 9. Test results shall be reported in writing to Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 - 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
 - 11. Additional Tests: Engineer shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been

met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents
Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

1. Reinforcement and verifying placement.
2. Headed bolts and studs.
3. Anchors post-installed into hardened concrete members.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Contractor to measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

E. Contractor to provide concrete mix batch tickets for each truck delivery of concrete.

F. Soil bearing surfaces beneath foundations shall be inspected by Architect or authorized representative to verify the required minimum design bearing capacity has been met or exceeded. The inspection shall be completed prior to placement of reinforcement and concrete.

END OF SECTION

SECTION 03 48 16 – PRECAST CONCRETE SPLASH BLOCKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Pre-cast concrete splash blocks for downspouts.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Provide unit configuration and dimensions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete Mix: Minimum 5000 PSI, 28 day strength, air entrained to 5 to 7 percent.

2.2 FABRICATION

- A. Use rigid molds constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
- B. Cure units to develop concrete quality, and to minimize appearance blemishes including non uniformity, staining and surface cracking.
- C. Minor patching in plant is acceptable, providing appearance of units is not impaired.
- D. Splash blocks:
 - 1. Nominal size: 4 inches high x 16 inches wide x 30 inches long.
 - 2. Provide raised lip at sides and rear edge.
 - 3. Finish: Manufacturer's standard.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Place a splash block under each downspout not located over walks or paving. Secure rigidly in place.
- B. Set level, on firm bearing.

END OF SECTION

SECTION 05 21 00

STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. Steel joist accessories.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.2 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates for the Manufacturer.
- B. Manufacturer certifications.
- C. Mill Certificates: For each type of bolt.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications".
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: If required, qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications".
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide joists and connections capable of withstanding design loads indicated on Drawings. Loads provided are at service levels (i.e. ASD) unless explicitly stated otherwise. Joist shall be limited to a vertical deflection of 1/360 of the span for live load only and 1/240 for total load.

2.2 STEEL JOISTS

- A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. K-Series Steel Joist Substitutes: Manufacture may provide this type of member according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members. Calculations must be provided demonstrating these members are capable of supporting specified loads
 - 2. Provide holes in chord members for connecting and securing other construction to joists.
 - 3. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
 - 4. Do not camber joists.

2.3 PRIMERS

- A. Primer:
 - 1. Joist painting is not required.

2. If paint is provided, use SSPC-Paint 15 or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.4 STEEL JOIST ACCESSORIES

- A. Bridging:
 1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated on Drawings.
- C. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.
 1. Extend ends to within 3/4 inch of finished wall surface unless otherwise indicated on Drawings.
- D. Welding Electrodes: Comply with AWS standards.
- E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications", joist manufacturer's written instructions, and requirements in this Section.
 1. Before installation, splice joists delivered to Project site in more than one piece.
 2. Space, adjust, and align joists accurately in location before permanently fastening.
 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

4. Where applicable, delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Attach joist to supporting steel with screw-type fasteners, as shown in the Drawings.
1. Field welding maybe be submitted for review as a substitute. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

- A. Touchup Painting:
1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, and accessories.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor must hire a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 05 31 00

STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Structural steel decking fabricated from material conforming to the latest edition of the American Iron and Steel Institute (AISI) Specifications.
- B. Section Excludes: Steel decking provided by the Metal Building Manufacturer. See Section 13 24 19.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Roof deck and floor deck for second floor.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
 - 2. Include section properties of the deck supplied, and ensure they meet the minimum requirements of the Contract Drawings.
 - 3. Deck shall be detailed to extend over multiple spans whenever possible. Where a single deck span is required, the Contractor shall drawings specific attention to this location on the shop drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Test and Evaluation Reports:
 - 1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.
 - b. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.
 - 2. Field Quality-Control Submittals:
 - a. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
 - 1. AWS D1.3 (Welding of sheet steel)

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ROOF DECK

- A. Manufacturers:
 - 1. Canam Steel Corporations; Canam Group, Inc.
 - 2. CMC Joist and Deck.
 - 3. New Millennium Building Systems, LLC.
 - 4. Vulcraft (Nucor)
- B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 40 minimum, G90 zinc coating.
 - 2. Deck Profile: Type "B" (narrow rib).
 - 3. Profile Depth: 1-1/2 inches.
 - 4. Design Uncoated-Steel Thickness: As indicated on Contract Drawings.
 - 5. Span Condition: Triple span or more.
 - 6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

- B. Mechanical Fasteners: As indicated on Contract Documents.
- C. Side-Lap Fasteners: As indicated on Contract Documents.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck and of thickness and profile recommended by SDI Standards for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- I. Flat Sump Plates: Single-piece steel sheet, of same material and finish as deck. For drains, cut holes in the field.
- J. Recessed Sump Pans: Single-piece steel sheet, of same material and finish as deck, with 3-inch-wide flanges and recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- K. Galvanizing Repair Paint: ASTM A 780, SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.
- L. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.

- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel and masonry supporting members as indicated on Contract Documents.
- B. Side-Lap and Perimeter Edge Fastening: Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, as indicated on Contract Documents, and at intervals not exceeding the lesser of one-half of the span or 36 inches.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.
- B. Repair Painting
 - 1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor to engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Special inspections and qualification of welding special inspectors for cold-formed steel roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 - b. Steel decking will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Interior non-load-bearing wall framing.
3. Ceiling joist framing.
4. Soffit framing.

B. Related Requirements:

1. Section 092116 "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Interior non-load-bearing wall framing.
4. Vertical deflection clips.
5. Single deflection track.
6. Double deflection track.
7. Drift clips.
8. Ceiling joist framing.
9. Soffit framing.
10. Sill sealer gasket.
11. Sill sealer gasket/termite barrier.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated-Design Submittal: Design and details of cold-formed steel framing that is not load-bearing is the responsibility of the Contractor.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of code-compliance certification for studs and tracks.
- C. Product Test Reports: Mill certificates or data from qualified in-house testing with calibrated test equipment, indicating each listed product complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
1. Steel sheet.
 2. Power-actuated anchors.
 3. Mechanical fasteners.
 4. Vertical deflection clips.
 5. Horizontal drift deflection clips
 6. Miscellaneous structural clips and accessories.
- D. Research Reports:
1. For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
 2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated. The following criteria is for non-load bearing partition walls and soffit construction.
1. Design Loads: Dead weight of partition wall and dead weight of components supported by soffits. See contract Drawings for detailed information. No live loads should be applied; use minimum 5psf lateral load for design of walls.
 2. Deflection Limits:
 - a. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.
 - b. Interior Furr-Out Framing: Vertical deflection of 1/240 of the horizontally projected span for total loads.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch.
- C. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, Grade 33 for thicknesses 43mils or less; Grade 50 for 54mils and thicker, Type H, metallic coated, of coating designation as follows:
1. Coating: G60 (metric Z180) or A60 (metric ZF180).
- B. Steel Sheet alternate: ASTM A653/A653M, SS Grade 33 for thicknesses 43mils or less; SS Grade 50 Class 1 for 54mils and thicker, zinc coated, of coating as follows:
1. Coating: G60 (metric Z180).

2.3 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0538 inch (i.e. 54 mils)
 2. Flange Width: 1-3/8 inches, 1-5/8 inches, or 2 inches as required by the contract Drawings.

- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch (i.e. 43 mils).
 - 2. Flange Width: As required by the contract Drawings.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch (i.e. 43 mils).
 - 2. Flange Width: 1-3/8 inches , 1-5/8 inches, or 2 inches as required by the contract Drawings.

2.4 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: See specifications Section 092116 "Gypsum Board Assemblies" for standard C-shaped steel studs.
- B. Steel Track: See specifications Section 092116 "Gypsum Board Assemblies" for standard U-shaped steel track
- C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1 inch plus the design gap for one-story structures.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 SOFFIT FRAMING

- A. Exterior Soffit Frame: See specifications Section 092116 "Gypsum Board Assemblies" for requirements.

2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Hole-reinforcing plates.
10. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Anchor Bolts: ASTM F1554, Grade 55, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.
- C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A780/A780M.
- B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, non-staining grout, complying with ASTM C1107/C1107M.
- C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- D. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.9 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/4 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
- B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
 2. Space studs as indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
 2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically 48 inches maximum. Fasten at each stud intersection.
1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
 4. Solid Blocking: Bridging consisting of cold-formed metal stud or track members modified as required for attachment.
- J. Install steel sheet diagonal bracing straps to stud or track flanges. Bracing straps shall be pre-tensioned, or otherwise guard against straps from being installed loose in the finished condition.

- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Connect vertical deflection clips to studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at centers indicated.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/4 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

- A. Testing: Hire a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports. The agency should be approved by the Owner and Architect prior to contracting.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 51 16 - METAL FLOOR PLATE STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Industrial Class stairs with steel floor plate treads.
2. Steel railings and guards attached to metal stairs.
3. Steel handrails attached to walls adjacent to metal stairs.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs, railings, and guards.
 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings and guards so wall attachments are made only to completed walls.
 1. Do not support railings and guards temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For metal floor plate stairs and the following:
 1. Metal floor plate treads.
 2. Woven-wire mesh.

3. Welded-wire mesh.
4. Shop primer products.
5. Grout.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

C. Delegated-Design Submittal: For stairs, railings, and guards, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the **State** in which Project is located.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 2. Protect steel members and packaged materials from corrosion and deterioration.
 3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
 - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, railings, and guards, including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft.
 - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/360.
- C. Structural Performance of Railings and Guards: Railings and guards, 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. applied in any direction.
 - b. Concentrated load of 200 lbf 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 applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- D. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallurgically bonded to steel.

- E. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- F. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal-diameter steel wire complying with ASTM A510/A510M.

2.3 FASTENERS

- A. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that comply with Section 09 90 00 "Interior Painting."
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs, railings, and guards in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 2. Locate joints where least conspicuous.
 3. Fabricate joints that will be exposed to weather in a manner to exclude water.
 4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
1. Fabricate stringers of steel plates or channels.
 - a. Stringer Size: As required to comply with "Performance Requirements" Article.
 - b. Provide closures for exposed ends of channel stringers.
 - c. Finish: Shop primed.
 2. Construct platforms and tread supports of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
 - a. Provide closures for exposed ends of channel framing.
 - b. Finish: Shop primed.
 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.

4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
 - a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from abrasive-surface floor plate of thickness needed to comply with performance requirements, but not less than 3/16 inch.
1. Form treads with integral nosing and back edge stiffener. Form risers from steel sheet not less than 0.097 inch thick, welded to tread nosings and stiffeners and to platforms.
 2. Weld steel supporting brackets to stringers and weld treads to brackets.
 3. Fabricate platforms with integral nosings matching treads and weld to platform framing.
- D. Risers: **Solid.**

2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

- A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."
- B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
1. Rails and Posts: 1-1/2-inch-diameter top and bottom rails and posts.
 2. Picket Infill: 1/2-inch-square pickets spaced to prohibit the passage of a 4-inch diameter sphere.
- C. Welded Connections: Fabricate railings and guards with welded connections.
1. Cope components at connections to provide close fit, or use fittings designed for this purpose.
 2. Weld all around at connections, including at fittings.
 3. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 4. Obtain fusion without undercut or overlap.
 5. Remove flux immediately.
 6. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #3 - Partially dressed weld with spatter removed as shown in NAAMM AMP 521.
- D. Form changes in direction of railings and guards as follows:
1. By bending or by inserting prefabricated elbow fittings.
- E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required.

1. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of railing and guard members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- H. Connect posts to stair framing by direct welding unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
1. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves.
 2. Provide type of bracket with predrilled hole for exposed bolt anchorage] and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.
- J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.
1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
 - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
 - 2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - 3. Comply with requirements for welding in "Fabrication, General" Article.

3.3 INSTALLATION OF RAILINGS AND GUARDS

- A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
 - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
 - 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
 - 4. Secure posts, rail ends, and guard ends to building construction as follows:
 - a. Anchor posts to steel by welding or bolting to steel supporting members.
 - b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.
- B. Attach handrails to wall with wall brackets.
 - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 - 2. Secure wall brackets to building construction as required to comply with performance requirements.

- a. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.4 REPAIR

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 90 00 "Interior Painting."

END OF SECTION

SECTION 07 90 00

JOINT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes sealants and joint backing, extruded silicone seal and accessories.
- B. Related Sections:
 - 1. Section 07 84 00 - Firestopping: Firestopping sealants.
 - 2. Section 08 45 00 – Translucent Wall and Roof Assemblies.
 - 3. Section 09 21 16 - Gypsum Board Assemblies: Acoustic sealant.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C834 - Standard Specification for Latex Sealants.
 - 2. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
 - 3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 5. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - 6. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
 - 7. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Samples: Submit two samples, illustrating sealant colors for selection.
- D. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.
- E. Warranty: Include coverage for installed sealants and accessories failing to achieve airtight seal, watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years experience, and approved by manufacturer.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 JOINT SEALERS

A. Manufacturers:		
	<u>CODE</u>	<u>MANUFACTURER</u>
	1. BOS	Bostir Findley, Inc., Middleton, MA
	2. DAP	DAP, Inc./Schering Plough Corp., Tipp City, OH
	3. DOW	DOW Chemical Co., Midland, MI
	4. MAM	Mameco International, Cleveland, OH
	5. OCC	Owens Corning, Toledo, OH
	6. PECO	Pecora Chemical Corp., Harleysville, PA
	7. PTI	Protective Treatments, Inc., Dayton, OH
	8. SIKA	Sika Chemical Corp., Lyndhurst, NJ
	9. SON	Contect, Inc., Sonneborn Building Products Div., Minneapolis, MN
	10. SUR	Surebond, Inc., Elk Grove Village, IL
	11. TREM	Tremco Manufacturing Co., Cleveland, OH
	12. USG	United States Gypsum Co., Chicago, IL
	13. WIL	Williams Products, Inc., Troy, MI

2.2 SEALANTS (Exterior and Interior)

- A. Generic description and Use:
 - 1. S-1: One component urethane, non-sag, gun grade elastomeric sealant or silicone rubber sealant. Use in all joints one-inch wide or less wherever movement may occur on interior or exterior, at contraction and expansion joints, masonry to

masonry, concrete building construction joints, door and window frames to masonry, metal to metal and sheet metal to masonry.

2. S-2: Two component urethane, non-sag, gun grade elastomeric sealant. Use in all joints wherever movement may occur in locations indicated for S-1 sealant.
3. S-3: One component urethane, pour grade, self-leveling elastomeric sealant. Use in exterior and interior contraction and expansion joints in sidewalks and pavements.
4. S-4: Acoustical sealant: Water based non-skinning and non-hardening synthetic sealant.

B. Acceptable products:

	<u>MFR/TYPE</u>	<u>S-1</u>	<u>S-2</u>	S-3	S-4
1.	MAM	Vulkem 116	Vulkem 227	Vulkem 45	
2.	OCC				Quiet Zone
3.	PECO	Dynatrol 1	Dynatrol II	Urexpan NR201	AIS-919
4.	SIKA	Sikaflex 15 LM	Sikaflex 12SL		
5.	SON	Sonalastic NPI	Sonalastic NPII	Sonalastic SLI	
6.	SUR	SB 188			
7.	TREM	Dymonic	Dymeric	THC-900	
8.	WIL	Dynaseal W-100			
9.	USG				Sheetrock acoustic sealant

2.3 CAULKS (Interior Only)

A. Generic description:

1. C-1: One part butyl gun grade.
2. C-2: One part acrylic gun grade.

B. Acceptable products:

	<u>MFR/TYPE</u>	<u>C-1</u>	<u>C-2</u>
1.	DAP	Butylflex	
2.	PECO	Bytyl BC 158	AC20 acrylic latex
3.	SIKA	Sikaflex 420	
4.	SON	Butakauk	Sonalac acrylic latex caulk
5.	TREM	Butyl sealant 400/500	Acrylic latex caulk
6.	BOS	Chem-Caulk 300	Chem-Caulk 600

2.4 JOINT FILLERS

A. General Description and Use:

1. JF-1: Backer rod for elastomeric sealants. Extruded closed-cell polyethylene foam or polyethylene jacketed polyurethane foam, non-bleeding, non-staining, oversized 30 to 50 percent.
2. JF-2: Preformed Fiber Joint Filler, asphalt-impregnated.
3. JF-3: Preformed Cork Expansion Joint Filler.

B. Acceptable Products:

	<u>MFR/TYPE</u>	<u>JF-1</u>	<u>JF-2</u>	<u>JF-3</u>
1.	DOW	Ethafoam		
2.	SON	Sonofoam Backer		Sonoflex Cork Rod
3.	WIL	Expand-O-Foam Cord		

2.5 JOINT CLEANER

- A. Type recommended by the manufacturer of the sealing or caulking compound for the specific joint surface and condition.

2.6 BOND BREAKER

- A. Polyethylene tape; pressure sensitive recommended by sealant manufacturer to suit application.

2.7 EXTRUDED SILICONE SEAL

A. Acceptable products:

1. Manufacturer/Product:

- a. Michael Rizza Company, LLC, Portland, OR, Telephone 503/760-8003; CE-100SX Silicone Compression/Extension Seal.
- b. Emseal Joint Systems Ltd., Westborough, MA, Telephone 800/526-8365; Seismic Colorseal.
- c. Substitutions: Section 01 60 00 - Product Requirements.

B. General Description and Use:

1. Compression seals are seismic joint seals extruded from silicone, self-expanding, complying with ASTM D2000, 4GE, 709M, and UV stabilized.
2. Seals are secured to adjoining surfaces with compatible sealant/adhesives as recommended by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify substrate surfaces and joint openings are ready to receive work.
- C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter impairing adhesion of sealant.
- B. Clean and prime joints.

- C. Perform preparation in accordance with ASTM C1193.
- D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

- A. Perform installation in accordance with ASTM C1193.
- B. Perform acoustical sealant application work in accordance with ASTM C919.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.
- H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- I. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.
- J. Top of walls and all wall penetrations in non-rated partitions to be sealed. See Section 07 84 00 for sealing requirements of fire and smoke rated partitions.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean adjacent soiled surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. Protect sealants until cured.

END OF SECTION

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes non-rated access doors and panels with frames.
 - 1. Provide for access to controls, valves, traps, dampers, cleanouts, and similar items requiring operation behind inaccessible finished surfaces.
 - 2. Coordinate with various trades to assure proper size and placement of access doors and panels.
- B. Related Sections:
 - 1. Section 09 21 16 – Gypsum Board Assemblies
 - 2. Section 09 90 00 – Painting and Coating: Field paint finish.
 - 3. Section 22 10 00 – Plumbing Piping.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. Underwriters Laboratories Inc.:
 - 1. UL – Building Materials Directory

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate exact position of access door units.
- C. Product Data: Submit literature indicating sizes, types, finishes, hardware, scheduled locations, fire resistance listings, and details of adjoining Work.
- D. Manufacturer's Installation Instructions: Submit installation requirements and rough-in dimensions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of access units.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified with minimum three years documented experience.

1.6 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work with work requiring controls, valves, traps, dampers, cleanouts, and similar items requiring operation being located behind finished surfaces.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS

- A. Manufacturers:
 - 1. J. L. Industries.
 - 2. Milcor LTD, Partnership.
 - 3. Nystrom Products Co.
 - 4. The Bilco Co.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Gypsum Board Access Doors: Frames and nominal 1-inch-wide flanges of 16 gage steel and door panels of 14 gage steel. Design flanges to be concealed by gypsum board joint finishing compound specified in Section 09 21 16.

2.2 FABRICATION

- A. Fabricate units of continuous welded construction; weld, fill, and grind joints to assure flush and square unit.
- B. Ceiling Access Door and Panel Hardware:
 - 1. Hinge: Standard continuous or concealed spring pin type, 175-degree steel hinges.
 - 2. Lock: Self-latching lock. Screwdriver slot for quarter turn cam lock.
- C. Size Variations: Obtain acceptance of manufacturer's standard size units which vary slightly from sizes shown or scheduled.

2.3 SHOP FINISHING

- A. Base Metal Protection: Prime coat units with baked on primer.
- B. Finish: Two coats field applied paint finish per Section 09 90 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify rough openings for access doors and panels are correctly sized and located.

3.2 INSTALLATION

- A. Secure frames rigidly in place, plumb and level in opening, with plane of door and panel face aligned with adjacent finished surfaces.
 - 1. Set concealed frame type units flush with adjacent finished surfaces.
- B. Position unit to provide convenient access to concealed work requiring access.

3.3 SCHEDULES

- A. Gypsum Board Ceilings: Gypsum board finish type, sized accordingly for access to concealed items, screwdriver slot lock, primed for field applied paint finish.

END OF SECTION

SECTION 08 33 13 - COILING COUNTER DOORS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Counter door assembly for Concessions Window.
2. Section 12 30 40 Casework for information on Stainless Steel Service Counter.

B. Related Requirements:

1. Section 13 34 19 Metal Building Systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

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.

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.

D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Guides.
2. Brackets.
3. Hood.
4. Locking device(s).
5. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

1.6 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.

2.2 COUNTER DOOR ASSEMBLY

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
 - 1. Cornell
 - 2. Cookson
 - 3. Clopay Building Products
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. 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.
- C. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
- D. Door Curtain Material: Stainless steel.
- E. Door Curtain Slats: Flat profile slats of 1-1/2-inch center-to-center height.
 - 1. Insulated-Slat Interior Facing: Metal.
 - 2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- F. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated stainless steel and finished to match door.
- G. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

- H. Hood: Match curtain material and finish
 - 1. Shape: Round or Square.
 - 2. Mounting: Face of wall.
- I. Integral Frame, Hood, and Fascia: Stainless steel.
 - 1. Mounting: Face of wall.
- J. Sill Configuration: Stainless Steel.
- K. Locking Devices: Equip door with locking device assembly and chain lock keeper.
 - 1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside with thumb-turn.
- L. Manual Door Operator: Push-up operation.
- M. Curtain Accessories: Equip door with weather-seals, push/pull handles, and pull-down strap.
- N. Door Finish:
 - 1. Stainless Steel Finish: ASTM A480/A480M No. 4 (polished directional satin).
 - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 DOOR CURTAIN MATERIALS AND FABRICATION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats 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. Stainless Steel Door Curtain Slats: ASTM A240/A240M or ASTM A666, Type 304; sheet thickness of 0.025 inch; and as required.
 - 2. 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.
 - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- 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.

2.4 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. Stainless Steel: 0.025-inch-thick, stainless-steel sheet, Type 304, complying with ASTM A240/A240M or ASTM A666.
- B. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):
 1. Stainless Steel: Type 304, complying with ASTM A240/A240M or ASTM A666.

2.5 LOCKING DEVICES

- A. 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: As standard with manufacturer and keyed to building keying system.

2.6 CURTAIN ACCESSORIES

- A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire perimeter of door for air-resistant installation unless otherwise indicated.
 1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.
- B. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.
- D. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

2.7 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.
 - 1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.
- 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.

2.8 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf.

2.9 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.

2.10 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: ASTM A480/A480M No. 4.

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 coiling counter 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 coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 DEMONSTRATION

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

END OF SECTION

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes aluminum-framed storefronts including aluminum and glass doors and frames including hardware and glass.
- B. Related Sections:
 - 1. Section 07 27 00 - Air Barriers: Perimeter air seal between glazing system and adjacent construction
 - 2. Section 07 90 00 - Joint Protection: System perimeter sealant and back-up materials.
 - 3. Section 08 71 00 - Door Hardware: Hardware reinforcement requirements affecting framing members; hardware items other than specified in this section.
 - 4. Section 08 80 00 - Glazing.
 - 5. Section 13 34 19 – Metal Building Systems

1.2 REFERENCES

- A. Aluminum Association:
 - 1. AA ADM 1 - Aluminum Design Manual.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 501 - Methods of Test for Exterior Walls.
 - 2. AAMA 502 - Voluntary Specification for Field Testing of Windows and Sliding Glass Doors.
 - 3. AAMA 503 - Voluntary Specification for Field Testing of Metal Storefronts, Curtain Wall and Sloped Glazing Systems.
 - 4. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
 - 5. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - 6. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - 7. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 8. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 9. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
 - 10. AAMA MCWM-1 - Metal Curtain Wall Manual.
 - 11. AAMA SFM-1 - Aluminum Store Front and Entrance Manual.

- C. American Society of Civil Engineers:
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

- D. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 4. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 5. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 6. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - 8. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
 - 9. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
 - 10. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
 - 11. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.

- E. National Fenestration Rating Council Incorporated:
 - 1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

- F. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

- G. SSPC: The Society for Protective Coatings:
 - 1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
 - 2. SSPC Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.

1.3 SYSTEM DESCRIPTION

- A. Aluminum-framed storefront system includes tubular aluminum sections with supplementary internal support framing, aluminum and glass entrances, shop fabricated, factory finished, glass and glazing, related flashings, anchorage and attachment devices.

- B. System Assembly: Site assembled.

1.4 PERFORMANCE REQUIREMENTS

- A. System Design: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners.
 - 1. As calculated in accordance with applicable code, as tested in accordance with ASTM E330.
 - 2. To design pressure of 20 pounds per square foot, as tested in accordance with ASTM E330.
- B. Deflection: Limit mullion deflection to 1/175 for spans under 13'-6" and 1/240 plus 1/4 inch for spans over 13'-6"; with full recovery of glazing materials.
- C. System Assembly: Accommodate without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.
- D. Air Infiltration: Limit air leakage through assembly to 0.06 cfm/min/sq ft of wall area, measured at reference differential pressure across assembly of 1.57 pounds per square foot as measured in accordance with ASTM E283.
- E. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
- F. Water Leakage: None, when measured in accordance with ASTM E331 with test pressure difference of 20 percent of design pressure, with minimum differential of 2.86 pounds per square foot and maximum of 12.00 pounds per square foot.
- G. Thermal Transmittance of Assembly (Excluding Entrances): Maximum U Value of 0.69 Btu/sq ft per hour per deg F when measured in accordance with AAMA 1503.
- H. Expansion / Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over 12 hour period without causing detrimental effect to system components and anchorage.
- I. System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.
- C. Product Data: Submit component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

- D. Design Data: Indicate framing member structural and physical characteristics, calculations, and dimensional limitations.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AAMA SFM-1 and AAMA MCWM-1 - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.

1.7 QUALIFICATIONS

- A. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum three years experience, and with service facilities within 100 miles of Project.
- B. Design structural support framing components under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Illinois.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing Work of this section.

1.9 DELIVERY, STORAGE, AND PROTECTION

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Handle Products of this section in accordance with AAMA MCWM-1 - Curtain Wall Manual #10.
- C. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install sealants nor glazing materials when ambient temperature is less than 40 degrees F during and 48 hours after installation.

1.11 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

1.12 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for glazed units.

PART 2 PRODUCTS

2.1 ALUMINUM-FRAMED STOREFRONTS

- A.

<u>Manufacturers:</u>	<u>Products:</u>
1. EFCO Corp. Monett, MO (800)221-4169	Exterior Doors: Series D518 Heavy Duty, Wide Stile Doors with System 403(T) Storefront.
2. Kawneer Co., Inc. Norcross, GA	Exterior Doors: 500 Tuffline Series Wide Stile Doors with Trifab VG451T Storefront System.
3. YKK AP America, Inc. Dublin, GA (314) 304-5182	Exterior Doors: Series 50D Wide Stile Doors with YES 45TU Thermal Storefront System.
4. Oldcastle Building Envelope Terrell, TX (972) 551-6100	Exterior Doors: Rugged WS 500 Series Wide Stile Doors with FG-3000 Thermal Storefront System.
5. Tubelite, Inc. Walker, MI (800) 866-2227	Exterior Doors: Wide Stile Doors with 14000 Series Storefront Framing.
6. Substitutions: Not permitted.	
- B. Product Description:
 - 1. Aluminum Frame: Thermally broken; flush glazing stops; drainage holes; internal weep drainage system. Frames for interior glazing need not to be thermally broken.
 - 2. Mullions: Profile of extruded aluminum with internal reinforcement of aluminum or shaped steel structural section.
 - 3. Doors: Aluminum framed glass doors; 1 3/4 inches thick, nominal 5 inch wide top rail and vertical stiles, nominal 10 inch wide bottom rail; square glazing stops.

2.2 COMPONENTS

- A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper typical, 6061 alloy, T6 temper for extruded structural members.
- B. Sheet Aluminum: ASTM B209, 5005 alloy, H15 or H34 temper.
- C. Sheet Steel: ASTM A653; galvanized to minimum G90.
- D. Steel Sections: ASTM A36; shaped to suit mullion sections, galvanized to G90.
- E. Glass: Specified in Section 08 80 00.
- F. Glazing Materials: Storefront manufacturer's standard types to suit application and to achieve weather, moisture, and air infiltration requirements.
- G. Hardware: Furnish manufacturer's standard door hardware for types of doors and applications indicated, and as specified below.
 - 1. Weather Stripping: Manufacturer's standard type to suit application, continuous and replaceable.
 - 2. Sill Sweep Strips: Resilient seal type, of neoprene compound.
 - 3. Threshold: Extruded aluminum, one piece for each door opening, ribbed. Specified in Section 08 71 00.
 - 4. Hinges: Continuous, geared type as specified in Section 08 71 00.
 - 5. Push/Pull: Style as selected from manufacturer's full range of available push/pulls.
 - 6. Panic Device: Specified in Section 08 71 00.
 - 7. Closer: Fully adjustable overhead concealed and exposed closer.
 - 8. Finish: Exposed hardware to match hardware finishes specified in Section 08 71 00.
 - 9. Lock Cylinders: Specified in Section 08 71 00.
 - 10. Lockset: Specified in Section 08 71 00.
- H. Flashings: Minimum 0.032-inch thick aluminum to match mullion sections where exposed.
- I. Air Barrier: Specified in Section 07 27 00.
- J. Sealant and Backing Materials:
 - 1. Sealant Used Within System (Not Used for Glazing): Manufacturer's standard materials to achieve weather, moisture, and air infiltration requirements.
 - 2. Perimeter Sealant: Specified in Section 07 90 00.
- K. Fasteners: Stainless steel.

2.3 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Arrange fasteners and attachments to conceal from view.
- E. Prepare components with internal reinforcement for door hardware.
- F. Reinforce framing members for imposed loads.

2.4 SHOP FINISHING

- A. Clear Anodized Aluminum Surfaces: AAMA 611, AA-M12C22A41 non-specular as fabricated mechanical finish, medium matte chemical finish, and Architectural Class I 0.7 mils clear anodized coating.
- B. Concealed Steel Items: Galvanized to ASTM A123; minimum 2.0 oz/sq ft coating thickness; Grade 85.
- C. Apply bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar metals.
- D. Touch-Up Primer for Galvanized Steel Surfaces: SSPC Paint 20 zinc rich.
- E. Extent of Finish:
 - 1. Apply factory coating to surfaces exposed at completed assemblies.
 - 2. Apply finish to surfaces cut during fabrication so no natural aluminum is visible in completed assemblies, including joint edges.
 - 3. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify dimensions, tolerances, and method of attachment with other Work.
- C. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

3.2 INSTALLATION

- A. Install wall system in accordance with AAMA MCWM-1 - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.
- B. Install head and sill receptors with end dams.
- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent Work.
- F. Provide thermal isolation where components penetrate or disrupt building insulation.
- G. Install sill flashings. Turn up ends and edges; seal to adjacent Work to form watertight dam.
- H. Coordinate attachment and seal of perimeter air and vapor retarder materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Install integral flashings and integral joint sealers.
- K. Set thresholds in full bed of mastic and secure.
- L. Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.
- M. Coordinate installation of glass with Section 08 80 00; separate glass from metal surfaces.
- N. Coordinate installation of perimeter sealants with Section 07 90 00.

3.3 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Plumb: 0.06 inches every 3 feet non-cumulative or 1/16 inches per 10 feet, whichever is less.
- C. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust operating hardware and sash for smooth operation.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Remove protective material from pre-finished aluminum surfaces.
- C. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- D. Remove excess sealant by method acceptable to sealant manufacturer.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. Protect finished Work from damage.

END OF SECTION

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

Mechanical and electrified door hardware

B. Section excludes:

Windows
Cabinets (casework), including locks in cabinets
Signage
Toilet accessories
Overhead doors

C. Related Sections:

Division 01 Section “Alternates” for alternates affecting this section.
Division 06 Section “Rough Carpentry”
Division 06 Section "Finish Carpentry”
Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
Division 08 Sections for Doors and Frames.

1.02 REFERENCES

A. UL, LLC

UL 10B - Fire Test of Door Assemblies
UL 10C - Positive Pressure Test of Fire Door Assemblies
UL 1784 - Air Leakage Tests of Door Assemblies
UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

Sequence and Format for the Hardware Schedule
Recommended Locations for Builders Hardware
Keying Systems and Nomenclature
Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

NFPA 70 – National Electric Code
NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
NFPA 101 – Life Safety Code

NFPA 105 – Smoke and Draft Control Door Assemblies
NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
ANSI/SDI A250.8 - Standard Steel Doors and Frames.
ANSI/DHI A115.IG – Installation Guide for Doors and Hardware

E. ICC – International Code Council, Inc

1. ICC/ANSI A117.1 – Accessible and Usable Buildings and Facilities.
2. ICC IBC – International Building Code

F. NFPA – National Fire Protection Agency

1. NFPA 101 - Life Safety Code
2. NFPA 80 - Fire Doors and Windows

G. Builders Hardware Manufacturing Association (BHMA)

1.03 SUBMITTALS

A. General:

Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
Prior to forwarding submittal:

- a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
- b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
- c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

- a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

Door Hardware Schedule:

- b. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
- c. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
- d. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

Key Schedule:

- e. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
- f. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
- g. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
- h. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
- i. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
- j. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
Provide Product Data:

- a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- b. Include warranties for specified door hardware.

D. Closeout Submittals:

Operations and Maintenance Data: Provide in accordance with Division 01 and include:

- a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
- b. Catalog pages for each product.
- c. Final approved hardware schedule edited to reflect conditions as installed.
- d. Final keying schedule
- e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:

- a. fire door assemblies, in compliance with NFPA 80.
- b. required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.

Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

- a. For door hardware: DHI certified AHC or DHC.
- b. Can provide installation and technical data to Architect and other related subcontractors.
- c. Can inspect and verify components are in working order upon completion of installation.
- d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

Fire-Rated Door Openings:

- a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
- b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

Smoke and Draft Control Door Assemblies:

- c. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
- d. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

Electrified Door Hardware

- e. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

Accessibility Requirements:

- f. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.

Pre-installation Conference

- b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- c. Inspect and discuss preparatory work performed by other trades.
- d. Inspect and discuss electrical roughing-in for electrified door hardware.

- e. Review sequence of operation for each type of electrified door hardware.
- f. Review required testing, inspecting, and certifying procedures.
- g. Review questions or concerns related to proper installation and adjustment of door hardware.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

1.07 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

Warranty Period: Beginning from date of Substantial Completion, for durations indicated.

- a. Closers:
 - 1) Mechanical: 30 years
- b. Exit Devices:
 - 1) Mechanical: 3 years.

- 2) Electrified: 1 year.
- c. Locksets:
 - 1) Mechanical: 10 years
 - 2) Electrified: 1 year.
- d. Continuous Hinges: Lifetime warranty.
- e. Key Blanks: Lifetime

Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance in section 01 25 00.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

A. Manufacturers and Products:

Scheduled Manufacturer and Product:

- a. Ives 5BB series

Acceptable Manufacturers and Products:

- b. Hager BB1191/1279 series
- c. McKinney TB series
- d. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
5. Provide minimum three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins

2.04 CONTINUOUS HINGES

A. Manufacturers

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Select
 - b. Best
 - c. Roton
 - d. ABH
 - e. Hager

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.

7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 FLUSH BOLTS

A. Manufacturers:

Scheduled Manufacturer:

- a. Ives

Acceptable Manufacturers:

- b. Burns
- c. Rockwood
- d. Trimco

B. Requirements:

Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 COORDINATORS

A. Manufacturers:

Scheduled Manufacturer:

- a. Ives

Acceptable Manufacturers:

- b. Burns
- c. Trimco
- d. Rockwood

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.07 MORTISE LOCKS

A. Manufacturers and Products:

Scheduled Manufacturer and Product:

- a. Schlage L9000 series

Acceptable Manufacturers and Products:

- b. Sargent 8200 series
- c. Corbin-Russwin ML2000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches. Provide motor based electrified locksets that comply with the following requirements:
 - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
 - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
 - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
 - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate "hot levers" in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
 - e. Connections – provide quick-connect Molex system standard.
 - f. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

2.08 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

Scheduled Manufacturer and Product:

- a. Schlage ND series

Acceptable Manufacturers and Products:

- b. Sargent 11-Line
- c. Corbin-Russwin CL3100 series

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

2.09 EXIT DEVICES

A. Manufacturers and Products:

Scheduled Manufacturer and Product:

- a. Von Duprin 99/33A series

Acceptable Manufacturers and Products:

- b. Precision APEX 2000 series
- c. Sargent 19-43-GL-80 series

C. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide grooved touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.

7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets..
14. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
15. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.10 CYLINDERS

A. Manufacturers:

Scheduled Manufacturer and Product:

- a. Coordinate with owner on final Cylinder to be installed.

Acceptable Manufacturers and Products:

- b. Schlage Everest 29 Primus XP
- c. Corbin-Russwin Pyramid High Security
- d. Medeco 3
- e. Sargent DG3

B. Requirements:

1. Provide construction cores prior to final installation of permanent cylinder
2. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
3. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. High Security: dual-locking cylinder with permanent core requiring restricted, patented keyway. Dual-locking mechanism with interlocking finger pin(s) to check for patented features on keys.

4. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
5. Nickel silver bottom pins.

2.11 KEYING

Replaceable Construction Cores.

- 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - a) 3 construction control keys
 - b) 12 construction change (day) keys.
- 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

Permanent Keying:

- b. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
- c. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
- d. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
- e. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- f. Quantity: Furnish in the following quantities.
 - 1) Permanent Control Keys: 3.
 - 2) Master Keys: 6.
 - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 4) Key Blanks: Quantity as determined in the keying meeting.

2.12 KEY CONTROL SYSTEM

A. Manufacturers:

Scheduled Manufacturer:

- a. Telkee

Acceptable Manufacturers:

- b. HPC
- c. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.13 DOOR CLOSERS

A. Manufacturers and Products:

Scheduled Manufacturer and Product:

- a. LCN 4040XP series

Acceptable Manufacturers and Products:

- b. Corbin-Russwin DC8000 series
- c. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.14 DOOR TRIM

A. Manufacturers:

Scheduled Manufacturer:

- a. Ives.

Acceptable Manufacturers:

- b. Elmes
- c. Trimco
- d. Burns
- e. Rockwood

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.15 PROTECTION PLATES

A. Manufacturers:

Scheduled Manufacturer:

- a. Ives

Acceptable Manufacturers:

- b. Burns
- c. Trimco
- d. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.16 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

Scheduled Manufacturers:

- a. Glynn-Johnson

Acceptable Manufacturers:

- b. Rixson
- c. Sargent
- d. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.17 DOOR STOPS AND HOLDERS

A. Manufacturers:

Scheduled Manufacturer:

- a. Ives

Acceptable Manufacturers:

- b. Trimco
- c. Burns
- d. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other, and overhead stop cannot be used.

2.18 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

Scheduled Manufacturer:

- a. Zero International

Acceptable Manufacturers:

- b. National Guard
- c. Reese
- d. DHSI
- e. Legacy
- f. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.19 SILENCERS

A. Manufacturers:

Scheduled Manufacturer:

- a. Ives

Acceptable Manufacturers:

- b. Burns
- c. Rockwood
- d. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.20 DOOR POSITION SWITCHES

A. Manufacturers:

Scheduled Manufacturer:

- a. Schlage

Acceptable Manufacturers:

- b. GE-Interlogix
- c. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

Standard Steel Doors and Frames: ANSI/SDI A250.8.

Custom Steel Doors and Frames: HMMA 831.

Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A

Installation Guide for Doors and Hardware: DHI TDH-007-20

- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- J. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- K. Closer/holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- L. Overhead Stops: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

- P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

Hardware Sets:

- 1) The hardware sets listed below represent design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process.

END OF SECTION

Hardware Group No. 01

For use on Door #(s):

112-A

Provide each PR door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
2	EA	CONT. HINGE	112XY	628	IVE
1	EA	PANIC HARDWARE	CD-9947-EO	626	VON
1	EA	PANIC HARDWARE	CD-9947-NL-OP	626	VON
3	EA	MORT CYLINDER	AS REQ'D	626	SCH
3	EA	AS REQUIRED	PRIMUS CONV. KIL CYLINDER	626	SCH
2	EA	90 DEG OFFSET PULL	8190EZHD 12" O	630- 316	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH MC	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
2	EA	DOOR CONTACT	7764	✎ 628	SCE
2	EA	CLOSER TEMPLATING, BRACKETS, SHOES, SPACERS, ETC	AS REQUIRED		
1	EA		BALANCE OF GASKETING BY DOOR/FRAME MFR.		

OPERATIONAL DESCRIPTION

ACTIVE LEAF

CONCEALED ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL AFTER RETRACTING LATCHBOLT WITH KEY/ THUMB TURN. DOGGING BY KEYED CYLINDER LOCKS DOWN THE PUSHBAR SO THE LATCHBOLT REMAINS RETRACTED AND DOOR FUNCTIONS AS A PUSH/PULL. SELF-CLOSING SPRING-LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

INACTIVE LEAF

CONCEALED ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY PULL WHEN DEVICE DOGGED DOWN. DOGGING BY KEYED CYLINDER LOCKS DOWN THE PUSHBAR SO THE LATCHBOLT REMAINS RETRACTED AND DOOR FUNCTIONS AS A PUSH/PULL. SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 02

For use on Door #(s):

105 108

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	626	SCH
1	EA	AS REQUIRED	PRIMUS CONV. KIL CYLINDER	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	328AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D	⚡ BLK	SCE

OPERATIONAL DESCRIPTION

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED. DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 03

For use on Door #(s):

106 107

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CORRIDOR LOCK	L9456L 06A L583-363 L283-722	626	SCH
1	EA	MORT CYLINDER	AS REQ'D	626	SCH
1	EA	AS REQUIRED	PRIMUS CONV. KIL CYLINDER	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH MC	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	328AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

OPERATIONAL DESCRIPTION

CORRIDOR LOCK - LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE. DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE OR INSIDE THUMBTURN. THROWING DEADBOLT LOCKS OUTSIDE LEVER. TURNING INSIDE LEVER SIMULTANEOUSLY RETRACTS DEADBOLT AND LATCHBOLT AND UNLOCKS OUTSIDE LEVER. INSIDE LEVER ALWAYS FREE FOR EGRESS. VISUAL INDICATOR DISPLAYS OCCUPIED/VACANT ON OUTSIDE FACE OF DOOR. SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

Hardware Group No. 04

For use on Door #(s):

101-A 101-B

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	LD-99-EO	626	VON
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O	630-316	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH MC	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	328AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	DOOR CONTACT	679-05HM OR WD AS REQ'D	BLK	SCE

OPERATIONAL DESCRIPTION

RIM EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. EXIT ONLY, NO EXTERIOR TRIM.

SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

DOOR POSITION SWITCH(S) MONITOR WHETHER THE DOOR IS OPEN OR CLOSED.

Hardware Group No. 05

For use on Door #(s):

104-B

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

FIRE RATED OPENING

OPERATIONAL DESCRIPTION

PASSAGE LOCK – NEITHER LEVER LOCKABLE. BOTH LEVERS ALWAYS FREE FOR IMMEDIATE INGRESS OR EGRESS.

SELF CLOSING.

Hardware Group No. 06

For use on Door #(s):

110

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CORRIDOR LOCK	L9456L 06A L583-363 L283-722	626	SCH
1	EA	MORT CYLINDER	AS REQ'D	626	SCH
1	EA	AS REQUIRED	PRIMUS CONV. KIL CYLINDER	626	SCH
1	EA	SURFACE CLOSER	4040XP MC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

FIRE RATED OPENING

OPERATIONAL DESCRIPTION

CORRIDOR LOCK - LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE. DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE OR INSIDE THUMBTURN. THROWING DEADBOLT LOCKS OUTSIDE LEVER. TURNING INSIDE LEVER SIMULTANEOUSLY RETRACTS DEADBOLT AND LATCHBOLT AND UNLOCKS OUTSIDE LEVER. INSIDE LEVER ALWAYS FREE FOR EGRESS. VISUAL INDICATOR DISPLAYS OCCUPIED/VACANT ON OUTSIDE FACE OF DOOR. SELF CLOSING.

Hardware Group No. 07

For use on Door #(s):

109

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53LD RHO	626	SCH
1	EA	AS REQUIRED	PRIMUS CONV. KIL CYLINDER	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

FIRE RATED OPENING

OPERATIONAL DESCRIPTION

OFFICE LOCK - TURN/PUSH-BUTTON LOCKING; PUSHING AND TURNING BUTTON LOCKS OUTSIDE LEVER, REQUIRING USE OF KEY UNTIL BUTTON IS MANUALLY UNLOCKED. PUSHBUTTON LOCKING; PUSHING BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED BY KEY OR BY TURNING INSIDE LEVER. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

Hardware Group No. 08

For use on Door #(s):

112-C

Provide each PR door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	9947-L-F-LBR-06	626	VON
1	EA	FIRE EXIT HARDWARE	9947-L-F-LBRAFL-06	626	VON
2	EA	RIM CYLINDER	AS REQ'D	626	SCH
2	EA	AS REQUIRED	PRIMUS CONV. KIL CYLINDER	626	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH MC	689	LCN
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	ASTRAGAL	ASTRAGAL AS REQ'D BY DOOR MFR	D	ZER

FIRE RATED OPENING

OPERATIONAL DESCRIPTION

BOTH LEAVES

CONCEALED ROD EXIT DEVICE. FREE EGRESS AT ALL TIMES BY PRESSING PUSHBAR. ENTRY BY TURNING LEVER UNLESS LOCKED BY KEY. KEY LOCKS AND UNLOCKS LEVER SELF-CLOSING. SPRING LOADED STOP INCLUDED. PUSH SIDE MOUNTED.

Hardware Group No. 09

For use on Door #(s):

111 112-B

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	626	SCH
1	EA	AS REQUIRED	PRIMUS CONV. KIL CYLINDER	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

FIRE RATED OPENING

OPERATIONAL DESCRIPTION

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

Hardware Group No. 10

For use on Door #(s):

102 103 104-A

Provide each SGL door(s) with the following:

QT		DESCRIPTION	CATALOG NUMBER	FINIS	MFR
Y				H	
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC CLASSROOM LOCK	CO-100-CY-70-KP-RHO-L 48 BATTERY	626	SCE
1	EA	PRIMUS K-I-L CYL	20-765-XP	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA MC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

FIRE RATED OPENING

OPERATIONAL DESCRIPTION

STOREROOM LOCK - OUTSIDE LEVER FIXED. ENTRANCE BY KEY ONLY. INSIDE LEVER ALWAYS UNLOCKED. INSIDE LEVER IS ALWAYS FREE FOR IMMEDIATE EGRESS. SELF CLOSING.

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes glass glazing, rated and non-rated for hollow metal frames, doors, glazed walls, aluminum curtain walls, and aluminum storefronts.
 - 1. Glass glazing materials and installation requirements are included in this section for other sections referencing this section.
- B. Related Sections:
 - 1. Section 07 90 00 - Joint Protection: Sealant and back-up material other than glazing sealants.
 - 2. Section 08 11 13 – Hollow Metal Doors and Frames
 - 3. Section 08 41 13 - Aluminum-Framed Entrances and Storefronts.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.
- B. American Society of Civil Engineers:
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International:
 - 1. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - 2. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - 3. ASTM C1036 - Standard Specification for Flat Glass.
 - 4. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
 - 5. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
 - 6. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - 7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 8. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 9. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 10. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
 - 11. ASTM E576 - Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position.
 - 12. ASTM E773 - Standard Test Methods for Seal Durability of Sealed Insulating Glass Units.
 - 13. ASTM E774 - Standard Specification for Sealed Insulating Glass Units.
- D. Consumer Products Safety Commission:
 - 1. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing.

- E. Glass Association of North America:
 - 1. GANA - Sealant Manual.
 - 2. GANA - Glazing Manual.
- F. National Fire Protection Association:
 - 1. NFPA 80 - Standard for Fire Doors, Fire Windows.
 - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- G. Underwriters Laboratories Inc.:
 - 1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
 - 2. UL - Building Materials Directory.

1.3 PERFORMANCE REQUIREMENTS

- A. Interior Glass Deflection: Design glass partition system to withstand live loads in accordance with 2009 International Building Code with maximum L/120 deflection.
- B. Interior glass at full height glazed partitions shall comply with CPSC 16 CFR 1201 Category II.
- C. Structural Design: Design in accordance with 2009 International Building Code for most critical combination of wind, seismic, and dead loads.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Glass: Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
 - 2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify full range of available colors where exposed.
- C. Design Data:
 - 1. Submit design calculations for glass resisting wind loads and live loads signed and sealed by a professional engineer licensed in the State of Illinois.
- D. Samples:
 - 1. Glass: Submit two samples 12 x 12 inch in size, illustrating each glass units, coloration and design.
 - 2. Glazing Materials: Submit 12-inch-long bead of glazing sealant and gaskets, color as selected.
- E. Manufacturer's Certificate: Certify sealed insulating glass, meets or exceeds specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum three years experience.
- B. Design glass resisting wind and live loads under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Illinois.

1.7 PRE-INSTALLATION MEETING

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week before starting Work of this section.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install glazing when ambient temperature is less than 50 degrees F.
- C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish ten year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 PRODUCTS

2.1 GLAZING

- A. Manufacturers:
 - 1. PPG Industries, Inc.
 - 2. Pilkington LOF.
 - 3. SAFTI *FIRST* Fire Rated Glazing Solutions.
 - 4. Substitutions: Section 01 60 00 – Product Requirements.

2.2 COMPONENTS

- A. Safety Glass (Type SG): CPSC 16 CFR 1201 Category II, minimum thickness 1/4 inch unless otherwise indicated. Safety glass shall be labeled, and label shall be visible after glazing.
 - 1. Clear Tempered Glass (Type SG-CT): ASTM C1048, Kind FT Fully tempered, Condition A, uncoated, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select; with horizontal tempering.

2. Tinted Tempered Glass (Type SG-TT-1): ASTM C1048, Kind FT Fully tempered, Condition A, Type 1 transparent flat, Class 2 tinted heat-absorbing and light reducing, Quality q3 glazing select.
 - a. Tint: Gray (Solarban 67 Optigray from Vitro or equal).
 3. Tinted Tempered Glass (Type SG-TT-2): ASTM C1048, Kind FT Fully tempered, Condition C, Type 1 transparent flat, Class 2 tinted heat-absorbing and light reducing, Quality q3 glazing select with Low E coating.
 - a. Tint: Gray (Solarban R67 Optigray from Vitro or equal).
- B. Fire Protective Glass (Type FP): FireLite Plus or Pyran Platinum L, laminated ceramic safety glazing conforming to NFPA 252 and ANSI Z97.1. Fire Protective Glass shall be permanently labeled, and label shall be visible after glazing.
1. Fire Rating: 90 minutes.
 2. Glass Thickness: 5/16 to 3/8 inch.
 3. Visible Light Transmittance: 85 percent minimum.
 4. Weight: 4 pounds per square foot.
 5. STC: 36 minimum.
 6. Safety Rating: CPSC Category II.
- C. Insulated Glass Units (Type IG-1): Total unit thickness 1 inch.
1. Double Pane Insulated Glass Units: ASTM E774 Class A and E773; with silicone sealant edge seal; purge interpane space with dry hermetic air.
 - a. Outer Pane: Glass Type: SG-TT-1.
 - b. Inner Pane: Glass Type SG-TT-2 with Low E coating on third glass surface form building exterior.
 - c. Visible Light Transmission: 25 percent.
 - d. Shading Coefficient: 0.28.
 - e. Solar Heat Gain Coefficient: 0.24.
 2. Insulated Glass Unit Edge Seal Construction: Aluminum mitered and spigoted corners.

2.3 ACCESSORIES

- A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, insulating glass seals, and glazing channels.
1. Silicone Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component; chemical curing; capable of water immersion without loss of properties; non-bleeding, non-staining, cured Shore A hardness of 15 to 25.
 - a. Acceptable Manufacturers and products:
 - 1) General Electric – “Silpruf”.
 - 2) General Electric – “Silglaze 2400”.
 - 3) Woodmount Products – “Chem-Caulk 1000”.
 - 4) Dow Corning – “790”.
 - 5) Pecora – “863”.
 - b. Color: As selected by Architect / Engineer.
 - c. Structural Silicone: Furnish high-modulus structural silicone glazing materials where sealant bonds glass to substrate.

- B. Glazing Gaskets: ASTM C864 Option I or II, resilient polyvinyl chloride extruded shape to suit glazing channel retaining slot.
 - 1. Color: Black.
- C. Pre-Formed Glazing Tape: Size to suit application.
 - 1. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal.
- D. Setting Blocks: ASTM C864 Option I, Neoprene, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- E. Spacer Shims: ASTM C864 Option I, Neoprene, 50 to 60 Shore A durometer hardness, minimum 3-inch-long x one half the height of glazing stop x thickness to suit application, self adhesive on one face.
- F. Fire-Resistant Glazing Materials: Materials used to obtain required fire-resistant rating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify openings for glazing are correctly sized and within acceptable tolerance.
- C. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

- A. Perform installation in accordance with GANA Glazing Manual.
 - 1. Glazing Sealants: Comply with ASTM C1193.
 - 2. Fire Rated Openings: Comply with NFPA 80.
- B. Interior Wet/Dry Method (Tape and Sealant) Installation:
 - 1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
 - 2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

3. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
 4. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
 5. Fill gaps between pane and applied stop with elastomeric glazing sealant to depth equal to bite on glazing, to uniform and level line.
 6. Trim protruding tape edge.
- C. Interior Wet Method (Compound and Compound) Installation:
1. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24-inch centers, kept 1/4 inch below sight line.
 2. Locate and secure glazing pane using glazers' clips.
 3. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Monitor quality of glazing.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Remove glazing materials from finished surfaces.
- C. Remove labels after Work is complete.
- D. Clean glass and adjacent surfaces.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. After installation, mark pane with an 'X' by using removable plastic tape or paste.

3.7 SCHEDULE

- A. Exterior Storefront and Doors, Transoms and Sidelites: Drawing designation "GL-1" Type IG-1, blue/gray tint, wet/dry method with silicone glazing sealant.
- B. Interior Non-Fire Rated Doors and Frames: Drawing designation "GL-2" Type SG-CT, interior wet method with paintable polyurethane glazing sealant.
- C. Interior Fire Rated Metal Doors and Frames: Drawing designation "GL-3", use Type FP for 90-minute rating at openings less than or equal to 100 square inches.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-Structural metal stud wall framing.
2. Gypsum board and joint treatment.
3. Acoustic insulation.
4. Metal wall furring.

B. Related Requirements:

1. Section 05 40 00 – Cold-Formed Metal Framing.
2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking.
3. Section 07 84 00 – Firestopping.
4. Section 09 51 13 – Acoustical Panel Ceilings.

1.2 REFERENCE STANDARDS

A. ASTM International:

1. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
2. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board.
3. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
4. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
5. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
6. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
7. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
8. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
9. ASTM C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.
10. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
11. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
12. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing.
13. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets.

14. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets.
15. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
16. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
17. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
18. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
19. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

B. American National Standards Institute:

1. ANSI A108.11- Specifications For Interior Installations Of Cementitious Backer Units.
2. ANSI A118.9 - Test Methods and Specifications for Cementitious Backer Units.

C. American Society of Civil Engineers:

1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

D. Gypsum Association:

1. GA 214 - Recommended Levels of Gypsum Board Finish.
2. GA 216 - Application and Finishing of Gypsum Board.
3. GA 600 - Fire Resistance Design Manual Sound Control.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

F. National Fire Protection Association:

1. NFPA 265 - Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Coverings on Full Height Panels and Walls, Method B.
2. NFPA 286 - Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Wall and Ceiling Interior Finish.

G. Underwriters Laboratories Inc.:

1. UL - Fire Resistance Directory.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on metal framing, gypsum board, joint tape, and acoustic accessories.

C. Shop Drawings:

1. Indicate special details associated with acoustic seals.
2. Indicate installation details required for seismic design loads.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C840, ASTM C1280; GA-214, GA-216 and GA-600.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Manufacturer List:
 - 1. CertainTeed.
 - 2. Georgia-Pacific.
 - 3. National Gypsum Co.
 - 4. United States Gypsum Co.
- B. Performance / Design Criteria:
 - 1. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated according to ASCE 7 and applicable codes for Seismic Design Category indicated on Drawings.

2.2 COMPONENTS

- A. Framing Materials:
 - 1. Studs and Tracks: ASTM C645; GA-216 and GA-600; galvanized sheet steel, 20 gauge minimum, unless indicated otherwise on drawings; C shape, of depth as shown on Drawings.
 - 2. Furring, Framing, and Accessories: ASTM C645, GA-216 and GA-600.
 - 3. Fasteners: ASTM C1002, screws.
 - 4. Anchorage to Substrate: Tie wire, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
 - 5. Seismic Bracing: As required for seismic performance requirements.
- B. Gypsum Board Materials: ASTM C1396.
 - 1. Fire Rated Gypsum Board: ASTM C36; fire resistive type, UL or WH rated; 5/8-inch thick, maximum available length in place; ends square cut, tapered edges.
 - 2. Moisture Resistant Gypsum Board: ASTM C630; 5/8-inch thick, maximum available length in place; ends square cut, tapered edges.

2.3 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced, 4 inch thick.
- B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

- C. Gypsum Board Accessories: ASTM C1047; plastic; corner beads, edge trim, and expansion joints.
 - 1. Plastic Accessories: PVC plastic.
- D. Joint Materials: ASTM C475; GA-216; reinforcing tape, joint compound, and water.
- E. Gypsum Board Screws: ASTM C1002; length to suit application.
 - 1. Screws for Steel Framing: Type S.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify site conditions are ready to receive work and opening dimensions are as indicated on shop drawings and as instructed by manufacturer.

3.2 INSTALLATION

- A. Metal Stud Installation:
 - 1. Install studs in accordance with ASTM C754, ASTM C1007, GA-216 and GA-600.
 - 2. Metal Stud Spacing: 16 inches on center.
 - 3. Refer to Drawings for indication of partitions extending stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
 - 4. Door Opening Framing: Install double studs at door frame jambs. Install stud track at frame head height.
 - 5. Blocking: Nail wood blocking to studs.
- B. Ceiling Framing Installation:
 - 1. Install in accordance with ASTM C754 and GA-216.
 - 2. Coordinate location of hangers with other work.
 - 3. Install ceiling framing independent of walls, columns, and above ceiling work.
 - 4. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing.
 - 5. Laterally brace entire suspension system as required for seismic design category as indicated on Drawings.
- C. Acoustic Accessories Installation:
 - 1. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
 - 2. Install acoustic sealant within partitions.

D. Gypsum Board Installation:

1. Install gypsum board in accordance with GA-216 and GA-600.
2. Erect single layer fire rated gypsum board horizontally, with edges and ends occurring over firm bearing.
3. Use screws when fastening gypsum board to metal furring or framing.
4. Double Layer Applications: Use fire rated gypsum backing board for first layer, placed perpendicular to framing or furring members.
 - a. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer.
5. Place control joints consistent with lines of building spaces, as per manufacturer's recommendations consistent with lines of building spaces and at all openings.
6. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials as indicated on Drawings.
7. Install cementitious backing board over metal studs.
8. Install abuse-resistant gypsum board, as specified in Paragraph 2.2.C.2, to height of 8 feet above floor level at gypsum board partitions throughout building.
9. Install moisture resistant gypsum board at walls and suspended gypsum board ceilings as scheduled on Drawings.

E. Joint Treatment:

1. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
2. Feather coats on to adjoining surfaces so that camber is maximum 1/32 inch.

3.3 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet.

3.4 SCHEDULE

A. Finishes in accordance with GA-214 Level:

1. Level 1: Above finished ceilings concealed from view.
2. Level 5: Walls exposed to view.

END OF SECTION

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes suspended metal grid ceiling system, perimeter trim and acoustic panels, and accessories.
- B. Related Requirements:
 - 1. Section 07 90 00 - Joint Protection.
 - 2. Section 23 37 00 - Air Outlets and Inlets: Air diffusion devices in ceiling system.
 - 3. Section 26 51 00 - Interior Lighting: Light fixtures in ceiling system.
 - 4. Section 28 31 00 - Fire Detection and Alarm: Fire alarm components in ceiling system.
 - 5. Section 21 13 13 – Wet-Pipe Sprinkler Systems: Sprinkler heads in ceiling system.

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 2. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 5. ASTM E580 - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
 - 6. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.
- B. Ceilings and Interior Systems Construction Association:
 - 1. CISCA - Acoustical Ceilings: Use and Practice.
- C. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH - Certification Listings.
- D. National Fire Protection Association:
 - 1. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building materials.
 - 2. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

- E. Underwriters Laboratories Inc.:
 - 1. UL - Fire Resistance Directory.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 PERFORMANCE REQUIREMENTS

- A. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:240.

1.4 SYSTEM DESCRIPTION:

- A. Continuous/Wall-to-Wall

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on metal grid system components and acoustic units.
- C. Shop Drawings:
 - 1. Indicate grid layout and related dimensioning, junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to system. Indicate method of suspension where interference exists.
 - a. Indicate installation details required for seismic design loads.
- D. Samples:
 - 1. Submit two samples 4 x 4 inch in size illustrating material and finish of acoustic units.
 - 2. Submit two samples each, 12 inches long, of suspension system main runner, cross runner, perimeter molding.
- E. Manufacturer's Instructions: Submit special procedures, perimeter conditions requiring special attention.

1.6 QUALITY ASSURANCE

- A. Conform to CISCA requirements.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum three years experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

- B. Convene minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Maintain uniform temperature of minimum 55 degrees F, and maximum humidity of 65 to 70 percent prior to, during, and after acoustic unit installation.

1.10 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Sequence Work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- C. Install acoustic units after interior wet work is dry.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish 2.5 percent of total acoustic unit area of extra panels to Owner.

1.12 WARRANTY

- A. Acoustical 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 the following:
 - 1. Acoustical Panels: Sagging and warping
 - 2. Grid System: Rusting and manufacturer's defects
- B. Warranty Period:
 - 1. Ceiling System: Thirty (30) 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.

1.13

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 SUSPENDED ACOUSTICAL CEILINGS

A. Manufacturers:

1. Armstrong World Industries:
 - a. Type 1: Ultima
 - b. Type 2: Cortega
2. Substitutions: Section 01 60 00 - Product Requirements.

2.3 COMPONENTS

A. Acoustic Panels (Type 1): ASTM E1264, conforming to the following:

1. Size: 24 x 24 inches.
2. Thickness: 3/4 inch.
3. Composition: Mineral.
4. NRC Range: 0.60 to 0.80.
5. Edge: Beveled.
6. Surface Color: White.
7. Surface Texture: Fine.
8. Mold/Mildew Resistance.

B. Acoustic Panels (Type 2): ASTM E1264, conforming to the following:

1. Size: 24 x 24 inches.
2. Thickness: 5/8 inch.
3. Composition: Mineral.
4. NRC Range: 0.55 to 0.75.
5. Edge: Beveled.
6. Surface Color: White.
7. Surface Texture: Medium.
8. Mold/Mildew Resistance.

C. Grid:

1. Non-fire Rated Grid: ASTM C635, Heavy Duty; exposed T components die cut and interlocking, Seismic "D".
 - a. Armstrong: Prelude XL.
 - b. Substitutions: Section 01 60 00 - Product Requirements.

2. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
3. Exposed Grid Surface Width: As per applicable code for seismic design category indicated on Drawings.
4. Grid Finish: White color.
5. Accessories: Stabilizer bars, clips, splices, perimeter moldings, and hold down clips, as required for suspended grid system.
6. Support Channels and Hangers: Galvanized Primed steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

2.4 ACCESSORIES

- A. Touch-up Paint: Type and color to match acoustic and grid units.
- B. Seismic Bracing: As required to meet seismic performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout of hangers will not interfere with other work.

3.2 INSTALLATION

- A. Seismic Design Category: D
- B. Lay-In Grid Suspension System:
 1. Install suspension system in accordance with ASTM C636 and as supplemented in this section.
 2. Install suspension system in accordance with ASTM E580.
 3. Install system capable of supporting imposed loads with maximum deflection of 1/240 maximum.
 4. Locate system on room axis according to reflected plan.
 5. Install after major above ceiling work is complete. Coordinate location of hangers with other work.
 6. Install hanger clips during steel deck erection. Install additional hangers and inserts as required.
 7. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
 8. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers and related carrying channels to span extra distance.
 9. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.
 10. Do not eccentrically load system, or produce rotation of runners.
 11. Perimeter Molding:

- a. Install edge molding at intersection of ceiling and vertical surfaces
 - b. Use longest practical lengths.
 - c. Miter corners.
 - d. Install at junctions with other interruptions.
12. Install light fixture boxes constructed of acoustic panel above light fixtures in accordance with UL assembly requirements and light fixture ventilation requirements.
 13. Laterally brace entire suspended system as required for seismic design category as indicated on Drawings.
- C. Acoustic Units:
1. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
 2. Install units after above ceiling work is complete.
 3. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
 4. Cutting Acoustic Units:
 - a. Cut to fit irregular grid and perimeter edge trim.
 - b. Cut square reveal edges to field cut units.
 5. Where bullnosed concrete block corners and round obstructions occur, install preformed closures to match perimeter molding.
 6. Install hold-down clips to retain panels tight to grid system within 20 feet of exterior door.

3.3 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- C. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

Section 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 WORK INCLUDES

- A. Base Bid:
 - 1. General Contractor to provide resilient base.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM F1861 - Standard Specification for Resilient Wall Base.
- B. Federal Specification Unit:
 - 1. FS L-F-475 - Floor Covering Vinyl, Surface (Tile and Roll), with Backing.
 - 2. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant.
- C. National Fire Protection Association:
 - 1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

- A. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Samples: Submit manufacturer's complete set of color samples for initial selection.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics:
 - 1. Base Material: Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect roll materials from damage by storing on end.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

2. PRODUCTS

2.1 RESILIENT BASE

- A. Manufacturers:
 - 1. Armstrong.
 - 2. Flexco.
 - 3. Johnsonite Inc.
 - 4. Roppe Corp.
- B. Base: ASTM F1861 Type TS – Vulcanized Rubber; coved style:
 - 1. Height: 4 inch.
 - 2. Thickness: 0.125 inch thick.
 - 3. Finish: Matte.
 - 4. Length: Coils in manufacturer's standard length.
 - 5. Outside corners: Job formed.
 - 6. Inside Corners: Job formed.
 - 7. Colors: AS selected by Architect/Engineer from manufacturer's standard colors.

2.2 ACCESSORIES

- A. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- B. Filler for Coved Base: Plastic.

3. EXECUTION

3.1 EXAMINATION

- A. Verify lower wall surfaces are free of substances or defects capable of impairing adhesion of new adhesive and finish materials.

3.2 INSTALLATION - BASE

- 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 practical without gaps at seams and with tops of adjacent pieces aligned. Maintain minimum dimension of 18 inches between joints.
- D. Fit joints tightly and make vertical.
- E. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- F. Install base on solid backing. Bond tightly to wall and floor surfaces.
- G. Scribe and fit to door frames and other interruptions.

3.3 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

- A. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of paints and other coatings.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
 - 2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. Green Seal:
 - 1. GC-03 - Anti-Corrosive Paints.
 - 2. GS-11 - Product Specific Environmental Requirements.
- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. Painting and Decorating Contractors of America:
 - 1. PDCA - Architectural Painting Specification Manual.
- E. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1113 - Architectural Coatings.
- F. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
- G. Underwriters Laboratories Inc.:
 - 1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on finishing products and special coatings.

- C. Samples:
 - 1. Submit two paper chip samples illustrating full range of colors available for each surface finishing product scheduled.
- D. Manufacturer's Installation Instructions: Submit special surface preparation procedures, and substrate conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 foot candle measured mid-height at substrate surface.

1.9 SEQUENCING

- A. Section 01 10 00 - Summary: Work sequence.

- B. Verify existing conditions and requirements of other trades before starting Work.
- C. Sequence application to the following:
 - 1. Do not apply finish coats until paintable sealant is applied.
 - 2. Back prime wood trim before installation of trim.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for paints and coatings.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Supply 1 gallon of each color, type, and surface texture; store where directed by Owner.
- C. Label container with color, type, and room locations, in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Manufacturers:
 - 1. The Glidden Co.
 - 2. MAB Paints.
 - 3. Benjamin Moore.
 - 4. Sherwin-Williams.
 - 5. Pittsburg Paints.
 - 6. Substitutions: Not permitted.

2.2 COMPONENTS

- A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
 - 1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
 - 2. For good flow and brushing properties.
 - 3. Capable of drying or curing free of streaks or sags.
- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve finishes specified; commercial quality.
- C. Patching Materials: Latex filler.
- D. Fastener Head Cover Materials: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions and requirements of other trades before starting Work.
- B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of Work. Report conditions capable of affecting proper application.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Do not apply paint pavement markings to concrete surfaces until concrete has cured for 28 days.
- F. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete and Concrete Unit Masonry: 12 percent.

3.2 PREPARATION

- A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces capable of affecting Work of this section. Remove or repair existing coatings exhibiting surface defects.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- G. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- H. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

- I. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.
- J. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Multiple colors shall be selected and accent walls shall be a component of the Project.
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- D. Sand wood and metal surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.
- G. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.
- H. Finishing Mechanical and Electrical Equipment:
 - 1. Refer to Division 22, Division 23, Division 26, and Division 27 for schedule of color-coding and identification banding of equipment, ductwork, piping, and conduit.
 - 2. Paint shop primed equipment.
 - 3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - 4. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are shop finished.
 - 5. Paint interior surfaces of air ducts visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, and grilles to match face panels.
 - 6. Paint exposed conduit and electrical equipment occurring in finished areas.
 - 7. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
 - 8. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

- B. Inspect and test questionable coated areas.

3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Protect Work of other trades and surfaces not being painted.
- B. Protect completed Work from damage by other trades.

3.7 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

- A. Hollow Metal Frames (Section 08 11 13): Exposed surfaces.
- B. Hollow Metal Doors (Section 08 11 13): Exposed surfaces.
- C. Access Doors (Section 08 31 13): Exposed surfaces of doors.

3.8 SCHEDULE - INTERIOR SURFACES

- E. Gypsum Board Ceilings:
 - 1. One coat SW PrepRite 200 Latex Primer; B28W200 or approved equal.
 - a. Four mils wet, 1.2 mils dry.
 - 2. Two coats SW ProMar 200 Latex Semi-Gloss; B300W200 or approved equal.
 - a. Four mils wet, 1.4 mils dry per coat.
- F. Gypsum Board Walls:
 - 1. One coat SW PrepRite 200 Latex Primer; B28W200 or approved equal.
 - a. Four mils wet, 1.2 mils dry.
 - 2. Two coats SW ProMar 200 Latex Semi-Gloss; B300W200 or approved equal.
 - a. Four mils wet, 1.4 mils dry per coat.
- G. Concrete Floor Sealant: Two Component Water-based Polyurethane Coating - Clear
 - 1. One Prime Coat 50.11725 H&C ClearProtect Water-Based 2 Part Polyurethane, Clear – Satin, or approved equal.
 - 2. One Finish Coat 50.11725 H&C ClearProtect Water-Based 2 Part Polyurethane, Celar – Satin, or approved equal.
- H. Plywood Flooring: Acrylic Floor Paint – Semi-Gloss Finish
 - 1. One Prime Coat B90W111 Armorseal Tread-Plex 100% Acrylic Floor Coating – thin 5% to allow for better penetration into the bare wood.
 - 2. One Finish Coat B90W111 Armorseal Tread-Plex 100% Acrylic Floor Coating.
- I. Steel:
 - 1. One coat SW Pro Industrial Pro-Cyrl Primer; B66-310 or approved equal.
 - a. Two to four mils dry.

2. Two coats SW ProMar 200 Alkyd Semi-Gloss, B34W200 or approved equal.
 - a. Four mils wet, 1.7 mils dry.

3.8 SCHEDULE – EXTERIOR SURFACES

A. Steel:

1. One coat SW Pro Industrial Pro-Cryl Universal Primer, B66-310 Series or approved equal.
 - a. Ten mils wet, 4 mils dry.
2. Two coats SW Metalatex Acrylic Semi-Gloss, B42 Series or approved equal.
 - a. Four mils wet, 1.5 mils dry per coat.

B. Steel Galvanized:

1. Two coats SW Metalatex Semi-Gloss, B42 Series or approved equal.
 - a. Four mils wet, 1.5 mils dry per coat.

END OF SECTION

SECTION 10 14 00
INTERIOR SIGNAGE

1. GENERAL

1.1 SUMMARY

A. Section includes interior signs.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.

C. Samples: Submit two full size signs illustrating type, style, letter font, and colors specified; method of attachment.

D. Manufacturer's Installation Instructions: Submit installation template and attachment devices.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Package signs, labeled in name groups.

C. Store adhesive attachment tape at ambient room temperatures.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install signs when ambient temperature is lower than recommended by manufacturer.

C. Maintain this minimum temperature during and after installation of signs.

2. PRODUCTS

2.1 INTERIOR SIGNS

A. Manufacturers:

1. Design Base: InPro Corporation – Aspen Collection.
 - a. Backplate: Standard color as selected by Architect / Engineer from manufacturer’s full range of color selections.
 - b. Faceplate: Solid color as selected by Architect / Engineer from manufacturer’s full range of color selections.
 - c. Style: ADA Room Identification 2” x 6”
 - d. Style: ADA Regulatory 8” x 6”
2. APCO Graphics – Approved Equal.
3. ASI Sign Systems – Approved Equal.
4. Daktronics, Inc. – Approved Equal.
5. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

- A. ADA compliant signs will consist of polyester based photopolymer, photoexposed and processed to achieve raised 1/32 inch raised letters and Braille. Photopolymer is then laminated to an acrylic back plate as required by the sign type. Copy color is to be applied by silk-screening or hot-stamping. Raised lettering and Braille are to be integral with the sign face. The following methods of producing raised letter and Braille are not acceptable:
 1. Glued-on plastic letters and Braille strips.
 2. Engraving or routing to achieve raised letters and Braille.
- B. Signs shall comply with ADA regulations with the requirements indicated for materials, thicknesses, finish, contrast, shapes, sized, and details of construction. Installed dimensional tolerances to be plus/minus 1/16 inch.
- C. Graphics to be precisely formed by manufacturer’s photomechanical stratification process to comply with the following:
 1. Braille: Grade 2 Braille including 189 part-work or whole work contractions in addition to Grade 1 Braille 63 characters. Tactile is required whenever Braille is required.
 2. Non-Tactile: Letters and numbers shall have a width-to-height ratio between 3:5 and 1:1 and stroke width ratio between 1:5 and 1:10 using upper case “X” to calculate ratios. Use typestyles with medium weight; upper and lower case lettering is not permitted; serif typestyles are not permitted.
 3. Symbols: Symbol itself is not required to be tactile but equivalent verbal description is required both in tactile letters and Braille.
 4. Tactile: 1/32 inch raised capital letters without serifs at least 5/8 inch height and not more than 2 inches height based on upper case “X”. Braille is required whenever tactile is required. **Individually applied characters are prohibited.**
 5. Pictogram Field: Pictograms and symbols of accessibility shall have a field height of 6 inches minimum. Characters and Braille shall not be located in the pictogram field.
 - a. Finish and Contrast: Pictograms and symbols of accessibility shall have a non-glare finish. Pictograms and symbols of accessibility shall contrast with their field with either a light pictogram on a dark field or a dark pictogram on a light field.

- b. Text Descriptors: Pictograms shall have text descriptors located directly below the pictogram field.

2.3 FINISHES

- A. Paints: Background color shall be applied, via spray application, over entire ADA (photopolymer) portion of plaque using air-dried polyurethane. Spraying copy color first followed by floor coating is prohibited. Roller coated copy is not acceptable.
- B. Finishes: Background and copy finish shall be clean, sharp and free of airborne debris and “orange peel” texture.
- C. Topcoat: Entire plaque shall be spray top coated with a clear matte urethane to protect the surface painted surface.

2.4 ACCESSORIES

- A. Tape Adhesive: Double sided tape, permanent adhesive.

3. EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Ensure surfaces are ready for sign installation.

3.2 INSTALLATION

- A. Install signs after surfaces are finished, in locations indicated on Drawings and as directed by Architect/Engineer.
- B. Locate sign on wall surface, level.
- C. Installation Location:
 - 1. Tactile characters on signs shall be located 48 inches minimum and 60 inches maximum above the finish floor surface, measured from the baseline of the lowest tactile character
 - 2. Locate signs containing tactile letters alongside the door at the latch side of single doors.
 - 3. Locate signs containing tactile letters on the inactive leaf of double doors.
 - 4. Locate signs containing tactile letters to the right side of double doors with two active leaves.
 - 5. Position sign containing tactile letters so that a clear floor space of 18 inches minimum by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.

END OF SECTION

SECTION 10 21 15

PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes solid plastic toilet compartment and urinal screens.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-in Place Concrete
 - 2. Section 06 10 53 - Misc. Rough carpentry
 - 3. Section 10 28 00 - Toilet Accessories.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. ASTM A 743/A 743M - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
 - 4. ASTM B 86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings.
 - 5. ASTM B 221 - Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 6. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. International Code Council (ICC)/American National Standards Institute (ANSI):
 - 1. ICC/ANSI A117.1 - Accessible and Usable Buildings and Facilities, as applicable to toilet compartments designated as accessible.
- C. National Fire Protection Agency:
 - 1. NFPA 286 – Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- D. 2018 Illinois Accessibility Code.
- E. United States Department of Justice:
 - 1. ADA - Americans with Disabilities Act, Excerpt from 28 CFR Part 36 - ADA Standards for Accessible Design.

1.3 SUBMITTALS

- A. Section 01 33 00 – Submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, section views, dimensions, details of wall and floor supports, door swings and attachment details. Show centerline of plumbing fixtures. Include choice of options with details.
- C. Product Data: Manufacturer’s data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Description of materials and finishes.
- D. Warranty: Submit sample of warranty.
- E. Samples for Selection: Furnish samples of manufacturer’s full range of colors for initial selection.
- A. Samples for Verification: Furnish physical sample of material in selected color.
 - 1. Size: 2 by 2 inch minimum, in type of finish specified.
- F. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance and cleaning instructions.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.
 - 1. Door Hinges: One hinge with associated fasteners.
 - 2. Latch and Keeper: One latch and keeper with associated fasteners.
 - 3. Door Bumper: One bumper with associated fasteners.
 - 4. Door Pull: One door pull with associated fasteners.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.
- B. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimal results. Do not install products under environmental conditions outside manufacturer’s absolute limits.

1.8 COORDINATION

- A. Coordinate Work with placement of support framing and anchors in wall.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation. Store in an upright condition.

1.10 WARRANTY

- A. Manufacturer guarantees its plastic against breakage, corrosion and delamination under normal conditions for a period of 15 years from the date of substantial completion.

1.11 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Approved manufacturer listed in this section, with minimum 5 years' experience in the manufacture of toilet compartments. Manufacturers seeking approval must submit the following in accordance with Instructions to Bidders and Division 01 requirements:
 1. Product data, including test data from qualified independent testing agency indicating compliance with requirements.
 2. Samples of each component of product specified.
 3. List of successful installations of similar products available for evaluation by Architect / Engineer.
- B. Installers Qualifications: Experienced Installer regularly engaged in installation of toilet compartments for minimum 3 years.
- C. Source Limitations: Obtain toilet compartment components and accessories from single manufacturer.
- D. Accessibility Requirements: Comply with requirements of ICC/ANSI 117.1, and with requirements of authorities having jurisdiction.
- E. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- F. Materials: Doors, panels and pilasters shall be constructed of High-Density Polyethylene (HDPE) resins. Partitions shall be fabricated from polymer resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self-lubricating surface that resists marks from pens, pencils, markers and other writing instruments. All plastic components shall be covered with a protective plastic masking.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver toilet compartments to site until building is enclosed and HVAC systems are in operation.

1. Deliver toilet compartments in manufacturer's original packaging.
2. Store in an upright condition.

PART 2 PRODUCTS

2.1 SOLID PLASTIC TOILET COMPARTMENTS

- A. Manufacturers:
 1. Bradley.
 2. Columbia Partitions.
 3. Accurate Partitions Corp.
 4. Scranton Products.
- B. Product Description:
 1. Toilet Compartment Type: Floor mounted, overhead braced toilet compartments.
 2. Urinal Screen Style: Wall hung with wing bracket.

2.2 COMPONENTS

- A. Toilet Compartments and Urinal Screens: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges and with homogenous color and pattern throughout thickness of material.
 1. Color: As selected by Architect / Engineer from manufacturer's full color range.
 2. Provide exposed surfaces free of pitting, visible seams and fabrication marks, stains or other imperfections.
 3. Provide aluminum heat sink at bottom edge of panels and doors.
- B. Door and Panel Dimensions:
 1. Door Width: 24 inch.
 2. Accessible Door Width: 36 inch, out-swinging.
 3. Ambulatory Accessible Door Width: 34 inch, out-swinging.
 4. Height: 55 to 58 inches, unless noted otherwise on Drawings.
- C. Urinal – Screen: Matching toilet compartment panel construction.

2.3 MATERIALS

- A. Zinc Aluminum Magnesium and Copper Alloy (Zamac): ASTM B 86.
- B. Stainless Steel Sheet: ASTM A 240 or A 666, Type 304.
- C. Stainless Steel Castings: ASTM A 743 or ASTM A 167, Type 304.
- D. Aluminum: ASTM B 221 or ASTM 6463-T5 alloy.
- E. Aluminum Castings" ASTM B 26.

2.4 ACCESSORIES

- A. Pilaster Shoe: Formed of solid plastic of color to match partition or 20 gage Type 305 stainless steel, 3 to 4 inches high, concealing floor fastenings. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
- B. Head Rails shall be made of heavy-duty extruded aluminum (6463-T5 alloy) with anti-grip design. The headrail shall have a clear anodized finish and shall be fastened to the headrail bracket by a stainless steel tamper resistant sex bolt, and fastened at the top of the pilaster with stainless steel tamper resistant screws.
 - 1. Headrail brackets shall be 20 gauge stainless steel with a satin finish and secured to the wall with a stainless steel tamper resistant screws.
- C. Wall Brackets: Full height, continuous stainless steel channel.
- D. Anchorage and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.
- E. Hardware: Heavy duty extruded aluminum (6463-T5 alloy):
 - 1. Hinges: Manufacturer's minimum 0.0781 inch thick stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through-bolts.
 - 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast stainless steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
 - 3. Coat Hook: Manufacturer's heavy-duty combination cast stainless steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts. Provide for each door.
 - 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast stainless steel bumper at out-swinging doors. Mount with through-bolts.
 - 5. Door Pull: Manufacturer's heavy-duty cast stainless steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

PART 3 EXECUTION

2.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Do not begin installation until substrates have been properly prepared for compliance with requirements for fastening, support, alignment, operating clearances and other conditions affecting performance.
- C. If substrate preparation is the responsibility of another installer, notify the Architect / Engineer of unsatisfactory preparation before proceeding.
- D. Verify field measurements are as indicated on shop drawings and as instructed by manufacturer.
- E. Verify correct spacing of and between plumbing fixtures.
- F. Verify correct location of built-in framing, anchorage, and bracing.

2.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

2.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilaster and Panels: ½ inch.
 - b. Panels and Walls: 1 inch.
 - 2. Full Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Located bracket fasteners so holes for wall anchors occur in masonry or tile joints.
- B. No evidence of cutting, drilling and / or patching shall be visible on the finished Work. Replace damaged or scratched materials with new materials.
- C. Overhead Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

2.4 ADJUSTING

- A. Section 01 70 00 - Execution: Testing, adjusting, and balancing.

- B. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 15 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.
- C. Adjust adjacent components for consistency of line or plane.

2.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

2.6 FINAL CLEANING

- A. Remove packaging and construction debris and legally dispose of off-site.
- B. Clean partition and screen surfaces with materials and cleansers in accordance with manufacturer's recommendations.

END OF SECTION 10 21 15

SECTION 10 26 00

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Corner guards.
 - 2. End-wall guards.
- B. Related Requirements:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry: Support blocking for corner guard anchors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
 - 2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
 - 1. Include plans, elevations, sections, and attachment details
- C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of exposed plastic material.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include

precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two 96 inch long units.
 - 2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.6 QUALITY ASSURANCE

- 1. Perform Work in accordance with State of Illinois Public Work's standard.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).
 - a. Store corner-guard covers in a vertical position.

1.8 WARRANTY

- 1. Provide manufacturers standard lifetime warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. InPro
 - 2. Substitution by A/E approval only
- B. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.

2.3 PRODUCTS

A. CORNER GUARDS

1. High Impact Surface Mount Corner Guard Profile
 - a. Profile: 3" x 3" x 8' standard heights with 90 – or 135 – degree profile.
 - b. Vinyl Cover: Snap on cover of .080" thickness shall be made shall be made from chemical and stain-resistant unplasticized polyvinyl chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added.
 - c. Retainer: Continuous aluminum retainer of .070") thickness shall be fabricated from 6063-T5 aluminum, with a mill finish.
 - d. Color and Texture to be selected by A/E or Owners Representative from manufacturer's full range.
 - e. Retainer Clips: Manufacturer's standard impact-absorbing clips.
 - f. Top and Bottom Caps: Prefabricated, injection-molded thermoplastic; color matching cover; field adjustable for close alignment with snap-on cover.
 - g. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawings shall be provided.

2.4 END-WALL GUARDS

A. Surface Mounted End Wall Protection

- a. Profile: 3" x 3" x 8' standard heights with 90 – or 135 – degree profile.
- b. Vinyl Cover: Snap on cover of .080" thickness shall be made shall be made from chemical and stain-resistant unplasticized polyvinyl chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added.
- c. Retainer: Continuous aluminum retainer of .070") thickness shall be fabricated from 6063-T5 aluminum, with a mill finish.
- d. Color and Texture to be selected by A/E or Owners Representative from manufacturer's full range.
- e. Retainer Clips: Manufacturer's standard impact-absorbing clips.
- f. Top and Bottom Caps: Prefabricated, injection-molded thermoplastic; color matching cover; field adjustable for close alignment with snap-on cover.
- g. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawings shall be provided.

2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work..
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
 - 1. Position corner guard from four inches above finished floor (above base material); unless noted otherwise on Drawings. Adjust end caps as necessary to ensure tight seams.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

END OF SECTION

SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes toilet room, shower and janitor room accessories.
- B. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous rough Carpentry: In-wall framing and plates.
 - 2. Section 10 21 15 - Plastic Toilet Compartments.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 4. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 6. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - 7. ASTM C1036 - Standard Specification for Flat Glass.
- B. Federal Specification Unit:
 - 1. FS A-A-3002 - Mirrors, Glass.

1.3 DESIGN REQUIREMENTS

- A. Design grab bars, shower seats and attachments to resist minimum 250 pound concentrated load applied at any point in any direction, forces as required by applicable code.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, and details of function, attachment methods.

- C. Manufacturer's Installation Instructions: Submit special procedures, and conditions requiring special attention.

1.5 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

PART 2 PRODUCTS

2.1 TOILET AND BATH ACCESSORIES

- A. Manufacturers:
 1. A & J Washroom Accessories.
 2. American Specialties, Inc.
 3. Bobrick Washroom Accessories.
 4. Bradley Corp.
 5. Koala Corp.
 6. Substitutions: Not permitted.

2.2 COMPONENTS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 1. Grind welded joints smooth.
 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Keys: Furnish 6 keys for each accessory to Owner; master key accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269, stainless steel.
- E. Mirror Glass: Float glass, Type I, Class 1, Quality q2 (ASTM C 1036), with silvering, copper coating, and suitable protective organic coating to copper backing in accordance with FS A-A-3002.
- F. Adhesive: Contact type, waterproof.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof.
- H. Expansion Shields: Fiber, or rubber as recommended by accessory manufacturer for component and substrate.

2.3 TOILET ROOM ACCESSORIES (Provide accessories as indicated on Drawings)

- A. Toilet Paper Dispenser: Non-controlled delivery unit; surface mounted roll-in-reserve type, designed to allow automatic activation of reserve roll when needed, or manual activation by pressing release bar, stainless steel unit with pivot hinge, tumbler lock and stainless steel dispensing mechanism.
- B. Towel Dispenser: Provided by Owner and installed by Contractor.
- C. Soap Dispenser: Provided by Owner and installed by Contractor.
- D. Mirrors: Stainless steel framed, 6 mm thick tempered glass mirror.
 - 1. Size: As indicated on Drawings.
 - 2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; No. 4 finish.
 - 3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and non-absorptive filler material.
- E. Grab Bars: Stainless steel, 1¼ inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1½ inches clearance between wall and inside of grab bar.
 - 1. Length and configuration: As indicated on Drawings.
 - 2. Length: 36 and 42 inches.
- F. Sanitary Napkin Disposal Unit: Stainless steel, back-to-back partition mounting with adjustable flanges, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
- G. Baby Changing Station: Shall be constructed of polypropylene and a unibody steel chassis, and shall support 200 pounds with minimal deflection. The station shall include child protection straps and bag hooks. Bed surface shall contain antimicrobial coating, reducing odor causing bacteria. Liner dispenser shall feature two liner cavities. Each cavity shall hold 25 liners, for a combined total of 50 liners per unit.

2.4 JANITOR ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Drying rod: Stainless steel, 1/4-inch diameter.
 - 2. Hooks: 3, 0.06 inch stainless steel rag hooks at shelf front.
 - 3. Mop/broom holders: 4 spring-loaded rubber cam holders at shelf front.
 - 4. Length: 36 inches.
 - 5. Provide shelf / mop and broom holder at Janitor 114.

2.5 FACTORY FINISHING

- A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, Type SC 2, satin finish, unless otherwise noted.

- C. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify exact location of accessories for installation.
- C. Verify field measurements are as indicated on product data.
- D. See Section 06 10 53 for installation of blocking, reinforcing plates and concealed anchors in walls.

3.2 INSTALLATION

- A. Install plumb and level, securely and rigidly anchored to substrate.
- B. Mounting Heights and Locations: As required by Illinois Accessibility Code and as follows:
 - 1. Bottom of Mirrors: 40 inches to bottom of reflecting surface.
 - 2. Grab Bars at Barrier-Free Stalls: 36 inches to centerline of grab bar.

3.3 SCHEDULES

- A. Toilet Tissue Dispenser.
 - 1. ASI: Model 20030.
 - 2. A & J: Model U840.
 - 3. Bradley: Model 5402.
 - 4. Bobrick: Model B-2888.
- B. Towel Dispenser:
 - 1. Provided by Owner, installed by Contractor.
- C. Soap Dispenser:
 - 1. Provided by Owner, installed by Contractor.
- D. Framed Mirror, 18 x 30 inches x ¼ inch tempered glass:
 - 1. ASI: Model 0620.
 - 2. A & J: Model U711.
 - 3. Bradley: Model 780.
 - 4. Bobrick: Model B-2990.
- E. Grab Bars, Length as indicated on Drawings.
 - 1. ASI: Model 3100.

2. A & J: Model G20.
3. Bradley: Model B-8320.
4. Bobrick: Model B-4806

F. Sanitary Napkin Disposal, surface mounted:

1. ASI: Model 0473-A.
2. A & J: Model U581SM.
3. Bradley: Model 4722-15.
4. Bobrick: Model B-254.

G. Baby Changing Station:

1. Koala Corp: Series KB300.
2. Bradley: Series 96.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes fire extinguishers; fire extinguisher cabinets; brackets for wall mounting, emergency access key lock-box.
- B. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking and shims.
 - 2. Section 09 21 16 – Gypsum Board Assemblies: Execution requirements for placement of rough-in frame for cabinets.

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 10 - Standard for Portable Fire Extinguishers.
- B. Underwriters Laboratories Inc.:
 - 1. UL - Fire Protection Equipment Directory.
 - 2. UL 1037
 - 3. UL 1610
 - 4. UL 1332
 - 5. UL 437

1.3 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.
- C. Provide fire extinguisher cabinets classified and labeled by Underwriters Laboratories Inc. for purpose specified and indicated.
- D. Provide high-security key lock box to be accessed by first-responders and emergency response personnel.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets, wall bracket mounted measurements, and final mounting locations.

- C. Product Data: Submit extinguisher operational features, color and finish, and anchorage details.
- D. Manufacturer's Installation Instructions: Submit special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Ansul Incorporated.
 - 2. General Fire Extinguisher Corp.
 - 3. JL Industries.
 - 4. Kidde Fire Extinguishers.
 - 5. Larsen's Manufacturing Co.
 - 6. Substitutions: Not permitted.
- B. Multi-purpose Dry Chemical (Type 1): 10 pound capacity, UL rating 2A-10B:C, steel cylinder, red enamel finish, pressure gauge, fully charged, in cabinets or on brackets as shown on Drawings.
- C. Wet Chemical (Type 2): 6 liter capacity, K class, UL rating 2A-1B:C:K, stainless steel cylinder, pressure gauge, fully charged, mount in Kitchen on wall bracket.

2.2 FIRE EXTINGUISHER CABINETS

- A. Manufacturers:
 - 1. JL Industries.
 - 2. Kidde Fire Extinguishers.
 - 3. Larsen's Manufacturing Co.

4. Substitutions: Section 01 60 00 - Product Requirements.

- B. Metal: Formed aluminum.
- C. Configuration: Recessed type, sized to accommodate accessories, 6 inch deep maximum wall penetration.
- D. Trim Type: Flat or returned to wall surface.
- E. Door: 0.016 inch thick, reinforced for flatness and rigidity; latch lock with break glass access.
- F. Door Glazing: Glass, clear, ¼ inch thick tempered.
- G. Cabinet Mounting Hardware: Appropriate to cabinet.
- H. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
- I. Pre-drill for anchors.
- J. Hinge doors for 180 degree opening with continuous piano hinge. Furnish nylon catch.
- K. Weld, fill, and grind components smooth.
- L. Glaze doors with resilient channel gasket glazing.
- M. Finishing Cabinet Exterior Trim and Door: Clear anodized aluminum.
- N. Finishing Cabinet Interior: white enamel.

2.3 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, red enamel finish.
- B. Graphic Identification: Provide red die cut letters spelling “Fire Extinguisher” on door.

2.4 EMERGENCY ACCESS KEY LOCK-BOX

- A. Manufacturers:
 - 1. Knox Company.
 - 2. Substitutions: Not permitted.
- B. Model Number:
 - 1. KnoxBox 3200

C. Description:

1. KnoxBox surface mount with hinged door. 1/4" plate steel housing, 1/2" thick steel door with interior gasket seal and stainless steel door hinge. Box and lock UL Listed. Lock has 1/8" thick stainless steel dust cover with tamper seal mounting capability.
2. Finish Color: Final finish color to be selected by A/E or Owner's representative from manufacturer's standard color selection. General contractor to provide physical samples for A/E and Owner's representative.
3. Contractor to coordinate with Mount Carmel Fire Department to receive all necessary authorizations and to confirm product meets their requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify rough openings for cabinet are correctly sized and located.
- C. Coordinate with Mount Carmel Fire Department and Owners representative on final installation location of emergency access key lock-box .

3.2 INSTALLATION

- A. Install cabinets plumb and level on wall or in wall opening, 54 inches from finished floor to top of cabinet.
- B. Secure rigidly in place.
- C. Place extinguishers and accessories in cabinets or on wall brackets as shown on drawings.
- D. Follow manufacturer's installation instructions.

END OF SECTION

SECTION 10 51 13

METAL LOCKERS

1. GENERAL

1.1 WORK INCLUDES

- A. Base Bid:
 - 1. General Contractor to provide metal lockers, locker room benches and accessories.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - a. Galvanized / Galvannealed process only required at locker base and bottom.
- B. Americans with Disabilities Act – Accessibility Guidelines.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate locker plan layout, and numbering plan.
- B. Product Data: Submit data on locker types, sizes and accessories.
- C. Samples: Submit two 3 x 6 inch in size, of each color scheduled; applied to specified base metal.
- D. Manufacturer's Installation Instructions: Submit installation template and attachment devices.

1.4 DELIVERY, STORAGE, AND PROTECTION

- A. Protect locker finish and adjacent surfaces from damage.

2. PRODUCTS

2.1 LOCKERS

- A. Manufacturers:
 - 1. Jorgenson Lockers
 - 2. List Industries, Inc.
 - 3. Penco Products, Inc.
 - 4. Republic Storage Systems Co., Inc.

5. Lyon Workspace Products.
6. Olympus Lockers.
7. WEC Lockers.
8. De Bourgh Manufacturing Company
9. Elite Manufacturing Company
10. Or approved alternate

2.2 MATERIALS

- A. Steel: Prime grad mild cold-rolled sheet steel, free from surface flaws. Must be compliant with ASTM A1008 and capable of taking a powder-coated enamel finish
- B. Sheet Steel: Mild, cold rolled and leveled unfinished steel; to the following minimum thicknesses:
 1. Vertical Side Panels: 13 gage expanded metal.
 2. Backs: 18 gage.
 3. Frame: 16 gage.
 4. Shelf: 16 gage.
 5. Door: 14 gage diamond perforated.
 6. Top: 16 gage.
 7. Bottom: 16 gage.
 8. Door Frame/Hinge Reinforcement: 18 gage.
 9. Hinges: 13 gage, 5 knuckle, 7 knuckle, or continuous.
- C. Hooks: Forged, Zinc-plated steel with ball ends.
- D. Nuts and Bolts: Truss fin head bolts and hex nuts, zinc-plated.

2.3 LOCKERS

- A. Locker Units: Single- Single Tier
 1. Width: 18 inches.
 2. Depth: 18 inches.
 3. Height: 72 inches.
 4. Configuration: Full height.
 5. Mounting: Freestanding.
 6. Base: 4 inch metal Z base.
 7. Ventilation Method: Doorless
- B. Locker Units: Single- Single Tier
 1. Width: 24 inches.
 2. Depth: 18 inches.
 3. Height: 72 inches.
 4. Configuration: Full Height
 5. Mounting: Freestanding.
 6. Base: 4 inch metal Z base.
 7. Ventilation Method: Doorless
- C. Locker Body: Formed and flanged; with steel stiffener ribs; fully welded.

- D. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
- E. Finish edges smooth without burrs.
- F. Furnish end panels and filler strips. Finish must match lockers. Attach with concealed fasteners.
- G. Fabricate 4 inch high steel Z bases. Flanged outward at top to support lockers, flanged inward at bottom for securing to floor.

2.4 ACCESSORIES

- A. Provide three single prong wall hooks and one double prong ceiling hook for each compartment of each double tier locker.
- B. Lockable Security Box
 - 1. Located between the top shelf and top of locker for single tier lockers.
 - 2. Door features a recessed cup handle and 2 five-knuckle hinges. Hinges are 2 inches tall and .074 inches thick.
- C. Lockable Footlocker – for single tier locker
 - 1. 14-gauge steel
 - 2. Ventilated front
 - 3. Hinged seat/hatch with continuous hinge
 - 4. Padlock loop
- D. Hooks: Forged, Zinc-plated steel with ball ends.
- E. Number Plates: Furnish rectangular shaped aluminum plates. Form numbers one inch high of block font style, in contrasting color.
- F. Front Fillers: 20-gauge steel molded to an angle shape. Includes 20-gauge slip joint angles formed at an angle shape with double bend on one leg forming a pocket to provide adjustable mating with angle filler.
 - 1. Attached with concealed fasteners.
 - 2. Finish must match lockers.
- G. Recess Trim: 18-gauge steel, 3 inch face dimension
 - 1. Vertical and/or horizontal as required.
 - 2. Standard lengths as long as practical.
 - 3. Attaches to lockers with hidden clips.
 - 4. Provide needed finish caps and splices.
 - 5. Finish must match lockers.
- H. Zee Bases for Knock-Down Lockers: 14-gauge steel. Flanged outward at top to support lockers, flanged inward at bottom for securing to floor. 4” inch height.

- I. Locker Room Benches: Stationary type; Floor mounted ADA Compliant, bench top of laminated hardwood; stained sealed and varnished; pedestals of stainless steel,
 - 1. Length: 42 inches.
 - 2. Width : 20 inches.
 - 3. Thickness: 1-1/4 inches.
 - 4. Seat Height: 17-1/2 inches from finish floor.
 - 5. Pedestals: 16-gauge stainless steel with holes for floor anchoring. Four pedestals per bench.

2.5 FABRICATION

- A. Construct lockers to be free from distortion. The units must be square, rigid, devoid of warp, and with flat metal faces.
- B. Confirm measurements and arrangement before construction.
- C. Finish: Enamel powder coat paint finish electrostatically applied and properly cured to manufacturer's specifications. No finishes containing volatile organic compounds and subject to out-gassing will be accepted. The color of the interior and exterior of the locker must match.
 - 1. Powder Coat-Dry thickness: 1 to 1.2 mils.
 - 2. Powder Coat Plus-Dry Thickness: 2 to 2.2 mils.
 - a. Color: As selected by A/E from manufacturers standard colors.

3. EXECUTION

3.1 Examination

- A. Do not begin set-up until substrates and bases have been correctly prepared.
- B. If substrate and bases are the responsibility of a third party, notify architect of unsatisfactory preparation before proceeding.

3.2 Installation

- A. Install metal lockers and accessories at locations shown, per agreement with manufacturer's instructions.
- B. Lockers must be installed plumb, level, and square.
- C. Anchor lockers to the floor and wall at 48 inches (1.219 m) or less, follow the manufacturer recommendation.
- D. Bolt adjoining units together to provide rigid installation.

- E. Install metal fillers using concealed fasteners. Provide even and flat hairline joints against neighboring surfaces.

3.3 Cleaning and Adjusting

- A. Adjust doors and latches to function without binding. Confirm that latches are functioning acceptably.
- B. Adjust built-in locks to avoid binding of dial or key. This will keep operation smooth prior to substantial completion.
- C. Fix flaws with factory-supplied paint and mend/replace damaged products before substantial completion.

3.4 Protection

- A. Shield installed products until completion of task.

END OF SECTION

SECTION 11 40 00

FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. The extent of Food Service Equipment is indicated on Drawings and by provisions of this section, including schedules and equipment lists associated with either Drawings or this section. Final plumbing and electrical connections are not work of this section. Final plumbing and electrical connections shall be furnished by others.

1.2 QUALITY ASSURANCE:

- A. Installer's Qualifications: Firm with at least three years of successful installation experience on projects with Food Service Equipment similar to that required for this project.
- B. Fabricator's Qualifications: Where indicated units that require custom fabrication, provide units fabricated by a shop, which is skilled, and with a minimum of five years of experience in similar work. Fabricate all custom equipment items at same shop. Where units cannot be fully shop-fabricated, complete fabrication work at project site.

1.3 REFERENCES:

- A. NSF Standards: Comply with applicable National Sanitation Foundation (NSF) standards and recommended criteria. Provide each principal item of food service equipment with a NSF Seal of Approval.
- B. UL Labels: Where available, provide UL labels on prime electrical components of Food Service Equipment. Provide UL Recognized marking on either items with electrical components, signifying listing UL, where available.
- C. ANSI Standards: Comply with applicable ANSI standard for electric powered and gas burning appliances, for piping to compressed gas cylinders, and for plumbing fittings including breakers and air gaps to prevent siphon age in water piping.
- D. NFPA Codes: Install Food Service Equipment in accordance with the following National Fire Protection Codes (NFPA) Codes:
 1. NFPA No. 54 – National Fuel Gas Code
 2. NFPA No. 70 – National Electrical Code
 3. NFPA No. 96 – Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

F. Health Code: Install Food Service Equipment in accordance with local health department applicable regulations.

1.4 COORDINATION

- A. Coordinate foodservice equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.
- B. Coordinate locations and requirements of utility service connections.
- C. Coordinate sizes, locations, and requirements of the following:
 - 1. Equipment bases.
 - 2. Floor sinks and drains serving foodservice equipment.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's technical products data and installation instructions for each item; include roughing-in dimensions, service connection requirements, performances, materials, manufacturer's model numbers, furnished accessories, power/fuel requirements, water/drainage requirements and other similar information.
- B. Shop Drawing: Submit dimensioned roughing-in drawings, at minimum scale of 1/4 inches = 1'-0", showing mechanical and electrical requirements. Submit dimensioned fabrication drawings for custom fabricated equipment including plans, elevations, and sections, at minimum of 3/4 inches = 1'-0", showing materials and gauges used.
- C. Maintenance Data: Submit maintenance data and parts lists for each item of food service equipment. Include in this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of 01010 General Requirements.\
- D. Warranty: Submit manufacturer's standard warranty.

1.6 DELIVERY, STORAGE AND HANDLING;

- A. Deliver Food Service Equipment in factory-fabricated containers designed to protect equipment and finish until final installation. Make arrangements to receive equipment at project site, or to hold in warehouse until delivery can be made to job site.
- B. Store Food Service Equipment in original containers and in location to provide adequate protection to equipment while not interfering with other construction operations.
- C. Handle Food Service Equipment carefully to avoid damage to components, enclosures, and finish. Do not install damaged Food Service Equipment, replace and return damage components to equipment manufacturer.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For food service equipment to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Product Schedule: For each foodservice equipment item, include the following:
 - 1) Designation indicated on Drawings.
 - 2) Manufacturer's name and model number.
 - 3) List of factory-authorized service agencies including addresses and telephone numbers.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with foodservice equipment by field measurements before fabrication. Indicate measurements on Coordination Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NSF Standards: Provide equipment that bears NSF Certification Mark or UL Classification Mark certifying compliance with applicable NSF standards.
- B. UL Certification: Provide electric and fuel-burning equipment and components that are evaluated by UL for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.
- C. Regulatory Requirements: Install equipment to comply with the following:
 - 1. ASHRAE 15, "Safety Code for Mechanical Refrigeration."
 - 2. NFPA 70, "National Electrical Code."
- D. Seismic Restraints: Comply with SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines," Appendix A, "Seismic Restraint Details," unless otherwise indicated.

2.2 SELF-CONTAINED REFRIGERATION EQUIPMENT

- A. Ice Making Machine.
 - 1. Manufacturers:

- a. Scotsmen – basis of design
 - b. Manitowoc
 - c. Hoshizaki
 - d. Or other as approved by A/E.
2. Description
- a. Freestanding Unit
 - b. Air Condenser Unit
 - c. 115v/60hz/1ph
 - d. 15.2 amps minimum
 - e. 18.0gal./100 lbs.
 - f. 525 lbs/24 hrs.
 - g. Medium Cube
 - h. R-404A refrigerant
 - i. 3 year parts and labor warranty on all components
 - j. 5 year parts and labor warranty on the evaporator
 - k. 5 year parts on the compressor and condenser
3. Accessories – Storage Bin
- a. 536 lb. holding capacity
 - b. Metallic finish
 - c. Spring loaded door with hidden hinges.
 - d. Built-in Scoop holder
 - e. 3 year parts and labor warranty on all components.

2.3 MISCELLANEOUS MATERIALS

- A. Installation Accessories, General: NSF certified for end-use application indicated.
- B. Elastomeric Joint Sealant: ASTM C920; silicone. Type S (single component), Grade NS (nonsag), Class 25, Use NT (nontraffic) related to exposure, and Use M, G, A, or O as applicable to joint substrates indicated.
1. Public Health and Safety Requirements:
- a. Sealant is certified for compliance with NSF standards for end-use application indicated.
 - b. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.
2. Cylindrical Sealant Backing: ASTM C1330, Type C, closed-cell polyethylene, in diameter greater than joint width.

2.4 FINISHES

- A. Stainless Steel Finishes:
- 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

- a. Run grain of directional finishes with long dimension of each piece.
- b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install food service equipment level and plumb, according to manufacturer's written instructions.
 1. Connect equipment to utilities.
 2. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.
- B. Complete equipment assembly where field assembly is required.
 1. Provide closed butt and contact joints that do not require a filler.
 2. Grind field welds on stainless steel equipment until smooth and polish to match adjacent finish.
- C. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.
- D. Install cabinets and similar equipment on bases in a bed of sealant.
- E. Install closure-trim strips and similar items requiring fasteners in a bed of sealant.
- F. Install joint sealant in joints between equipment and abutting surfaces with continuous joint backing unless otherwise indicated. Produce airtight, watertight, vermin-proof, sanitary joints.

3.2 CLEANING AND PROTECTING

- A. After completing installation of equipment, repair damaged finishes.
- B. Clean and adjust equipment as required to produce ready-for-use condition.
- C. Protect equipment from damage during remainder of the construction period.

3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain foodservice equipment.

END OF SECTION

SECTION 11 66 40

ATHLETIC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Perimeter netting system.
 - 2. Walk draw netting

- B. Related Sections:
 - 1. Section 13 34 19 – Metal Building Systems:

1.2 REFERENCES

- A. Equipment shall conform to the latest rules and regulations of the NCAA.

1.3 QUALITY ASSURANCE

- A. Netting system and all related accessories shall be provided by one manufacturer.

1.4 DESIGN REQUIREMENTS

- A. Design netting system to the following:
 - 1. Transfer loads to building roof structure to prevent overloading and damage to building.
 - 2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.

1.5 SUBMITTALS

- A. Section 01 33 00-Submittal Procedures: Submittal requirements.

- B. Manufacturer's product data, recommendations, and installation instructions for each type of athletic equipment specified.

- C. Shop Drawings: Submit the following:
 - 1. Athletic equipment diagrams showing dimensions, accessories, mounting brackets and support attachments.
 - 2. Installation details for all equipment.

- D. Samples: Submit color selections for all items requiring color selections to the Architect/Engineer.

1.6 PRODUCT DELIVERY

- A. Deliver to project site in manufacturer's original packaging.
- B. Athletic equipment to be handled and stored to prevent damage to materials, finishes and operating mechanisms.

1.7 GUARANTEES AND WARRANTIES

- A. Netting System: Provide manufacturer's standard warranty on netting and accessories.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. AALCO Manufacturing Company.
- B. Carron Net Company, Inc.
- C. Or approved equals.

2.2 ACCEPTABLE EQUIPMENT

- A. Perimeter netting.
- B. Ceiling netting.
- C. Walk draw netting.
- D. Mounting hardware and accessories.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to installation, field verify exact locations of netting. Inspect for conditions that would affect quality and execution of work.

3.2 INSTALLATION

- A. Install athletic equipment in accordance with approved shop drawings and manufacturer's instructions.
- B. Perimeter netting and ceiling netting to be joined at edges to prevent gaps between

- perimeter and ceiling.
- C. Walk draw curtains to be installed within perimeter and ceiling net. Install vinyl aprons along cable and ceiling to prevent gaps at the top of the nets between dividers.
- D. Provide a means to access lighting fixtures and other elements beyond ceiling netting for maintenance purposes.

3.3 FIELD QUALITY CONTROL

- A. Operate walk draw nets a minimum of three times to ensure proper drawing. Adjust as required to ensure smooth operation and accurate positioning.

3.4 CLEANING

- A. Remove protective wrappings, wash surfaces, and attach nets.

3.5 DEMONSTRATION

- A. Demonstrate to Owner's designated representative complete operation and required maintenance for divider curtains.
- B. Submit operation and maintenance manuals in accordance with Section 01 70 00- Execution Requirements.

END OF SECTION

SECTION 11 68 33

ATHLETIC FIELD EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Provide all equipment and materials, and do all work necessary to furnish and install Barrier Netting System as indicated on the drawings and as specified herein.

1.2 RELATED SECTIONS:

- A. Examine Contract Documents for requirements that affect work of this section. Other specification sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 03 30 00 - Cast-In-Place Concrete
 - 2. Section 31 05 13 Soils
 - 3. Section 31 05 16 Aggregates
 - 4. Section 31 10 00 Site Clearing
 - 5. Section 31 22 13 Rough Grading
 - 6. Section 31 23 16 Excavation Fill

1.3 REFERENCE:

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. National Collegiate Athletic Association (NCAA)
 - 2. National Junior College Athletic Association (NJCAA)
 - 3. Manufacturers Data and Recommended Installation Requirements.

1.4 SUBMITTALS

- A. Comply with Section 01 33 00 – Submittal Procedures/
- B. Manufacturers Product Data
 - 1. Provide manufacturer's product literature, technical specifications and other data prior to actual field installation work for Architect or Owner's Representative review.
 - 2. Samples: Submit physical samples for color selections for all items requiring color selections to the Architect/Engineer. Upon request provide duplicate samples for client.

C. Shop Drawings

1. Provide drawings of manufacturers recommended installation and foundation requirements prior to actual field installation work for Architect or Owner's Representative review.
2. Warranty Documentation: Manufacturer's warranties shall pass to the Owner and certification made that the product materials meet all applicable grade trademarks or conform to industry standards and inspection requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver all components grouped together in original manufacturer's packaging with labels clearly labeling manufacturer and contents. Materials delivered to the site shall be examined immediately for concealed damage or defects in shipping. Any defects shall be noted and reported to the Owner's Representative.
- B. Storage: Sound materials shall be stored above the ground under protective cover, or indoors, to provide proper protection.
- C. Handling: Handle all components in a fashion that protects and preserves all components and finishes during delivery, storage, and installation.
- D. Replacements: If necessary, replacements shall be immediately re-ordered to minimize any conflict with the construction schedule.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers and product selections named are provided to establish the minimum standard.
 1. Jaypro
 2. AAE
 3. Aalco
- B. Substitution Limitations
 1. Only with the approval of the architect will substitutions for materials specified, be allowed; see Section 01 25 00 – Substitution Procedures.
 2. The work has been designed and detailed based upon the first specified manufacturer's materials equipment, products, sizes, colors, etc. Contractors are

advised that any and all modifications to be contractor's scope of work or to new or existing work resulting from the contractor's approved substitution request shall be the sole responsibility of the contractor and shall be performed by the contractor at NO additional cost to the client/district.

3. Contractor shall notify architect, prior to bid time, of any items which are obsolete or will not be available for use in this project.
4. If the contractor's approved substitution request is a different size than the specified item, contractor shall adjust all supporting and surrounding construction as directed by the architect and as required for the different sized item, all at NO additional cost to the client/district.

2.2 MATERIALS

Customer determines the length of field netting.

- A. Posts: Straight Post 6.625 "O.D. x .280" wall x 423"lg., 30'-8" out of ground, 6061T6 aluminum extrusion with pre-drilled holes for mounting hardware, 6.625" O.D. x .150" wall x 72"lg. 6061T6 aluminum ground sleeve with a stop-bolt at 60". Typical spacing between posts 20' maximum. Black powder Coat.
- B. Net: 30' high, 1-3/4"sq. black UV-treated HTTP knotless net, #36 knotted nylon square, 1/4" MFP rope border all 4 sides, pre-attached sewn in 3/16" dia. galvanized clear coated cable
- C. Hardware: All stainless steel, galvanized and brass hardware, pulley system for raising/lowering net, 5/16" braided rope with pre-attached hardware, a cleat for rope tie-off, an eyebolt at bottom of post to secure net.
- D. Ground Sleeves with covers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions where equipment and systems are to be installed and notify the contractor of conditions detrimental to the proper and timely installation and completion of the work.
- B. Do not proceed with the work until unsatisfactory conditions have been corrected by the contractor in a manner acceptable and to the satisfaction of the Architect/Engineer or Owner's Representative.

3.2 INSTALLATION

- A. All athletic equipment shall be installed as indicated on approved submittals as recommended and in strict accordance with manufacturer's written directions and as indicated on the drawings and specified herein.
- B. All concrete footings for athletic equipment shall be installed as indicated on the drawings and in accordance with Section 03300, Cast-in-Place Concrete.
- C. All sleeves required for athletic equipment installation shall be set plumb and true to line and grade in concrete as indicated on the drawings and per manufacturer's recommendation.
- D. All athletic equipment shall be installed in strict accordance with the latest rules, regulations and specifications governing that sport or event for which it is being installed.

3.3 TESTING, ADJUSTMENT, AND OPERATION

- A. All athletic equipment requiring testing, adjustments and operation shall be tested for proper operation and adjusted to conform to specified standards.
- B. Provide certifications as required, indicating that equipment has been tested and adjusted to conform to specified standards.
- C. Provide operating and maintenance instructions and manuals to Owner -designated personnel for the proper operation and care of equipment after equipment has been tested and adjusted to conform to specified standards.

3.4 CLEANING

- A. Upon completion of work, clean the equipment free of dirt, mud or stains. Touch up scratches with matching paint.
- B. Do not use harsh cleaning materials or methods that would damage the finish.
- C. Do not remove warning labels or decals.
- D. Completely clean-up work area. Remove all trash and debris.

END OF SECTION

SECTION 12 30 40

GENERAL CASEWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Prefabricated plastic laminate casework, flush overlay design, as shown on Drawings, schedules and equipment lists.
 - 2. Stainless Steel Service Counter.
 - 3. Fillers, scribes, finished ends, finished backs, work surfaces/back splashes, and cutouts required providing a complete and finished project. Plastic laminate work surfaces shall include backer sheet.
 - 4. Locks where shown on casework drawings or described in equipment lists.
- B. Related Sections:
 - 1. Section 06 10 53 – Miscellaneous Rough Carpentry.
 - 2. Section 09 65 00 - Resilient Flooring, Rubber Base.

1.2 REFERENCES

- A. American National Standards Institute.
 - 1. ANSI A156.9 - Cabinets Hardware.
 - 2. ANSI A208.1 - Mat formed Particleboard.
- B. Architectural Woodwork Institute.
 - 1. AWI - Quality Standards Illustrated.
- C. National Electrical Manufacturers Association.
 - 1. NEMA LD3- High Pressure Decorative Laminates.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal Procedures.
- B. Shop drawings shall be submitted for approval within thirty days after formal notification of award of contract. Drawings shall consist of floor plans indicating arrangement and relation to adjacent work and equipment, and complete elevations of casework. Centerline of service requirements shall be noted for use by other trades. A schedule of all sinks, fittings, and accessories that are part of this contract shall be provided.
- C. Color samples shall be submitted for selection by Architect/Engineer. Samples of actual material and color shall be available as required.
- D. Additional catalog cuts, details and samples of hardware as requested by Architect / Engineer for evaluation and coordination.

1.4 QUALITY ASSURANCE;

- A. Manufacturer:
 - 1. Company specializing in manufacture of institutional and commercial plastic laminate casework with minimum of five years experience.
 - 2. Firm regularly engaged in manufacturer of stainless-steel fabrications of types, capacities, and sizes required, whose products have been in satisfactory use in similar service for not less than five years.
- B. Installer Qualifications:
 - 1. Installer with 5 years experience who has successfully completed installations of plastic laminate faced casework similar in material, design, and extent to that indicated for this project.
 - 2. Firm with at least three years of successful installation experience on projects with stainless steel fabrications similar to that required for this project.
- C. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Custom Grade.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect units from moisture damage.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. During and after installation of Work of this section, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.8 WARRANTY

- A. Casework manufacturer shall warrant for a period of three years, the product manufactured by it to be free from defects in material and workmanship when properly installed under normal use, but not limited to delamination, swelling or warping.

PART 2 PRODUCTS

2.1 GENERAL CASEWORK

- A. Manufacturers:

1. Casework and countertops:
 - a. Case Systems, Inc.
 - b. LSI Corporation of America, Inc.
 - c. Precision Millwork Company.
 - d. Reynolds & Doyle, Inc.
 - e. Stevens Cabinet Co., Division of Stevens Industries.
 - f. TMI Systems Design Corporation.
 - g. Wilson Kitchens, Inc.
 - h. Formica
 - i. Or other as approved by A/E.
2. Stainless Steel Countertop
 - a. Missouri Equipment Company
 - b. Stainless Supply
 - c. Onepointe Solutions
 - d. Commercial Stainless
 - e. Or other as approved by A/E

2.2 SURFACE MATERIALS

- A. Cabinet
 1. Exposed finish ends, fronts, modesty panels, and finish backs shall be faced with vertical grade PF-28 high pressure decorative laminate (HPL), tested under National Electrical Manufacturers Association (NEMA) LD3-2005. Decorative laminate shall be thermoset to core using catalyzed polyvinyl acetate (PVA) glue with minimum 80 pounds per square inch pressure and average 180 degrees F temperature.
 2. Panels with exterior PF-28 surfaces shall have 0.020 inch cabinet liner surface interior.
- B. Stainless Steel Counter Tops:
 1. Stainless-Steel Sheet: ASTM A240/A240M, Type 304 conforming to ASTM A 204/A 240M with #4 brushed finish on the exposed side, and a 2b shop finish on the other side.
 2. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 079200 "Joint Sealants" and the following:
 - 1) Mildew-Resistant Joint Sealant: Mildew resistant, single component, non-sag, neutral curing, silicone
 - 2) Color: Clear.

2.3 CORE MATERIALS

- A. Particleboard: Shall be high performance industrial grade core. Particleboard shall be 45 to 48 pound density 3-ply type formation conforming to ANSI A208.1 and ASTM D1037-91A standards.
- B. Medium Density Fiberboard: Core shall be minimum 48 pound density conforming to ANSI A208.1 MD-130 standards.

2.4 EDGINGS

- A. Door and Drawer Fronts: Edges shall have 0.020 inch flat edge extrusion banding to match face pattern and colors. Automated hot melt adhesive application and trimming.
- B. Cabinet Edges: Cabinet sides, top, bottom, adjustable shelves and other interior components shall be edged with 0.020 inch flat edge extrusion. Automated hot melt adhesive application and trimming.
- C. Drawer Components: $\frac{3}{4}$ inch and 1 inch sides shall be edged with 0.020 inch flat edge extrusion. Automated hot melt adhesive application and trimming.

2.5 HARDWARE

- A. Concealed Hinges: Shall be commercial grade 120 degree pivot overlay style. Hinges shall be two piece construction with door hinge and cabinet mounting plate. Hinges shall be compact design with minimally intrusive mechanism into compartment space. Hinges shall have spring loaded self-close feature. Hinges shall be provided two per door up to 47 inches in height, 3 per door up to 63 inches in height and 4 per door above 63 inches in height. Concealed hinges shall have 3 way (vertical, in-out, horizontal) alignment adjustments. Hinges shall be mounted with 5mm thread fasteners and nylon screw mount inserts.
- B. Door catches shall be a heavy-duty spring loaded, large diameter (17.5 mm) roller type catch mounted at door bottom. All doors over 48 inches in height shall be provided with roller catch at both top and bottom of door. Catch strike plate shall be injection molded with integral molded engagement ridge and wide face bumper door stop.
- C. Pulls shall be solid metal bent wire, 4 inches length, available in chrome or brass finish.
- D. Drawer and Slide Out Shelves Slides: Extension slides shall be bottom and side mount epoxy steel slides. Lateral stability achieved through a formed captive slide profile. Slides shall glide on nylon rollers and carry a 100 pound dynamic load rating. Slides feature both in and out drawer stop with 3 inch self close and adjustable cam side alignment. Slides shall also be tested under the Scientific Equipment and Furniture Association (SEFA) 6.5 Drawer Cycle Test.
- E. Full Extension Slides: Slides shall be side mounted with profile to not reduce interior drawer space normally provided. Ball bearing slides to be tested under The Business and Institutional Furniture Manufacturer's Association (BIFMA) X5.5 Section 7. Slides shall pass both 50,000 and 100,000 cycle test with a 120 pound load rating.
- F. Hanger Bars: Shall be heavy chrome plated oval tubing mounted in adjustable end wall sockets.
- G. Self-support clips for 1-inch thick adjustable shelves shall be injection molded clear polycarbonate. Support clips shall incorporate integral molded lock tabs to retain shelf from tipping or inadvertently being lifted out. Support clip shall have 5 mm diameter double pin engagement into precision bored hole pattern in cabinet vertical members.

Adjustment shall be 1 ¼ inch spacing. Clips shall have a molded ridge, which provides pressure against edge of shelving to maintain positive pin engagement. Clip shall be designed in such a manner to provide means for permanent retention to shelf. Static test load must exceed 200 pounds per clip. Shelf spans above 27 inches shall have 5-point support with backs drilled to receive a mid span shelf support.

- H. Locks: Shall be high security 6-tumbler lock system. Locks shall have diecast body with dead bolt engagement tang. Locks shall have removable and interchangeable core for easy field and customer re-keying. Locks shall be master keyed and available key-alike or key-different with 250 standard key changes and the possibility of up to 2000 total changes.

2.6 COMPONENTS

- A. Fronts: Door and drawer fronts shall be ¾ inch thick. Fronts shall be edged with 0.020 inch flat edge extrusion with face laminate. Automated hot melt adhesive application and trimming.
- B. Mounting frames incorporated in wall units, tall units, and base units, shall be ¾ inch thick with minimum two dowel pins per mounting frame end joint for wall and tall units. Base units shall have a minimum of three dowel pins per mounting frame end joint.
- C. Base cabinet components shall be ¾ inch throughout. Base unit bottoms shall incorporate back groove and up to eight dowel pins per end joints. Base units shall have a wide top and back frame feature. Construction shall provide lateral and vertical stability. Base cabinet ends shall be ¾ inch thick with back groove and precision Computer Numerical Control (CNC) drill pattern for accurate location of fixed members, hardware, and shelf supports.
- D. Toe Kicks: Bases shall be an integral base design. Construction of end panels, cabinet bottoms and horizontal toe kick members shall be integrally joined. Separate detached bases shall not be acceptable.
- E. Backs: Shall be in an integrated system of ¼ inch prefinished medium density fiberboard back captured in side and horizontal grooves. Unit back to be further integrated with attachment to ¾ inch doweled-in mounting frames. Fixed backs shall be mechanically fastened into groove and sealed with hot melt adhesive. Removable backs shall be set in groove and attached with screws.
- F. Adjustable Shelves: All adjustable shelves shall be 1 inch thick. Shelving shall have end 4 point support for spans under 27 inches and 5 point support with backs drilled to receive additional mid-span shelf support for spans over 27 inches.
- G. Drawers: Four sided full box design with separate attached front shall be provided. Drawer members shall be ¾ inch thick dowel pin construction at all four corners. Drawer bottoms shall be ¼ inch medium density fiberboard trapped in groove four edges as well as mechanically fastened.

2.7 LAMINATE TOPS

- A. Countertops shall be high pressure decorative laminate, thermoset to core using catalyzed PVA glue with minimum average pressure of 80 pounds per square inch and average 180 degree F temperature. Decorative laminate shall meet NEMA LD3-2005 PF-42 specification standards.
- B. Laminate tops shall be solid particleboard core structures and laminated with backer sheet.

2.8 STAINLESS STEEL COUNTER TOPS

- A. Fabricate #16-gauge stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects.
 - 1. Joints: Fabricate countertops without field-made joints.
 - 2. Weld shop-made joints.
 - 3. Sound deaden the undersurface with heavy-build mastic coating and reinforcement hat channels.
 - 4. Extend the top down to provide a 1-1/2 thick edge and 1/2 inch return flange.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The installer must examine the job site and the conditions under which the work in this section is to be performed, and notify the contractor in writing of any unsatisfactory conditions. Do not proceed with work under this section until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Casework, countertops, and related materials to be conditioned to average prevailing humidity condition in installation areas prior to start of work.
- C. Install casework and countertops with factory-trained supervision authorized by manufacturer. Casework shall be installed plumb, level, true and straight with no distortions. (Shim as required). Securely attached to building structure with anchorage devices of appropriate type, size and quantity to meet applicable codes, specifications, and safety conditions. Where laminate clad casework and countertop abuts other finished work, scribe and trim to accurate fit.
- D. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by the manufacturer.
- E. Repair, or remove and replace, defective work as directed upon completion of installation.

- F. Clean casework and touch up per manufacturer recommendations. Replace other damaged parts of units.
- G. Advise contractor of procedures and precautions for protection of casework and countertops from damage by other trades until acceptance of work by Owner.
- H. Cover casework with 4-mil polyethylene film for protection against soiling and deterioration during remainder of construction period.

END OF SECTION

SECTION 13 34 19

METAL BUILDING SYSTEMS

PART 1 – GENERAL

1.1 WORK INCLUDES

Base Bid: General Contractor provide pre-engineered, shop fabricated structural steel building frame; metal wall and slope roof system including gutters and downspouts.

1.2 METAL BUILDING SYSTEM COMPONENTS

- A. Single-Span rigid frames spaced at equal intervals.
- B. 14'-0" minimum clearance at knee.
65'-0" minimum from outer frame flange to outer frame flange.
12" maximum depth of end frame intermediate columns.
- C. Bay spacing of approximately 25'-10"; must maintain out-to-out dimensions of 130'-0".
- D. Roof Sloop: 2 in 12 (~9.46°).
- E. Primary Framing: Single-span rigid frames oriented in the direction shown in the Drawings. Member dimensions and details are by the Manufacturer. Tension-only braces for the other principal direction lateral system, in the bays indicated in the Drawings. End wall columns and girders as designed by the Manufacturer.
- F. Secondary Framing: Purlins, girts, eave struts, flange bracing, and other items as required by the building Manufacturer.
- G. Wall and Roof System: Preformed steel panels insulation, liner sheets, and accessory components.

1.3 RELATED SECTIONS

- A. Section 03 30 00: Concrete for footings, grade/tie beams, and floor slabs.
- B. Section 07 90 00: Joint Protection.
- C. Section 08 11 13: Hollow Metal Doors and Frames.
- D. Section 08 41 13: Aluminum-Framed Entrances and Storefronts.
- E. Section 09 90 00: Painting and Coating.

1.4 REFERENCES

- A. AISI S100, *North America Specification for the Design of Cold-Formed Steel Structural*

Members, Washington, DC.

- B. AISC 303, *Code of Standard Practice for Steel Buildings and Bridges*, American Institute of Steel Construction, Chicago, IL.
- C. AISC 360, *Specification for Structural Steel Buildings*, American Institute of Steel Construction, Chicago, IL.
- D. AISC, Steel Design Guide Series 3, *Serviceability Design Considerations for steel Buildings*, Chicago, IL.
- E. ANSI/ASHRAE/IES Standard 90.1, *Energy Standard for Buildings Except-Low-Rise Residential Buildings*, Atlanta, GA.
- F. ASTM A36, *Standard Specification for Carbon Steel*, West Conshohocken, PA.
- G. ASTM A123, *Standard Specification for Zinc Coating (Hot-Dip Galvanized) Coatings on Iron and Steel Products*, West Conshohocken, PA.
- H. ASTM A153, *Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware*, West Conshohocken, PA.
- I. ASTM A307, *Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod 60,000psi Tensile Strength*, West Conshohocken, PA.
- J. ASTM A463, *Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process*, West Conshohocken, PA.
- K. ASTM A475-03, *Standard Specification for Zinc-Coated Steel Wire Strand*, West Conshohocken, PA.
- L. ASTM A500, *Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes*, West Conshohocken, PA.
- M. ASTM A501, *Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing*, West Conshohocken, PA.
- N. ASTM A529, *Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality*, West Conshohocken, PA.
- O. ASTM A572, *Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel*, West Conshohocken, PA.
- P. ASTM A792, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process*, West Conshohocken, PA.
- Q. ASTM A792, *Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process*, West Conshohocken, PA.
- R. ASTM A1011-14, *Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength*, West Conshohocken, PA.

- S. ASTM C665-17, *Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing*, West Conshohocken, PA.
- T. ASTM E1514-98(2017)e1, *Standard Specification for Structural Standing Seam Steel Roof Panel Systems*, West Conshohocken, PA.
- U. ASTM E1592-95(2017), *Standard Test Method for Structural Performance of Sheet Metal roof and Siding Systems by Uniform Static Air Pressure Difference*, West Conshohocken, PA.
- V. ASTM E1646-95(2011), *Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference*, West Conshohocken, PA.
- W. ASTM E1680-16, *Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems*, West Conshohocken, PA.
- X. ASTM F3125, *Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated*, West Conshohocken, PA.
- Y. AWS A2.4, *Standard Symbols for Welding Brazing, and Nondestructive Examination*, Miami, FL.
- Z. AWS D1.1, *Structural Welding Code – Steel*, Miami, FL.
- AA. AWS D1.3, *Structural Welding Code – Sheet Steel*, Miami, FL.
- BB. MBMA, *Metal Building Systems Manual*, Metal Building Manufacturers Association, Cleveland, OH, 2018.
- CC. NAIMA 202, *Standard for Flexible Fiberglass Insulation to be Laminated for use in Metal Buildings*, 2000.
- DD. SJI, (Steel Joist Institute) – *Standard Specifications, Load Tables and Weight Tables for Steel Joist and Joist Girders*.
- EE. SSPC, (The Coatings Society) – SP2 – *Specification for Hand Tool Cleaning*, 2004 (Part of Steel Structures Painting Manual, Vol. Two)
- FF. SSPC, Paint 15 – *Steel Joist Shop Primer/Metal Building Primer*; 2004 (Part of Steel Structures Painting Manual, Vol. Two)
- GG. SSPC, - Paint 20 – Zinc-Rich Coating (*Type I – Inorganic, and Type II – Organic*); Society for Protective Coatings; 1991 (Part of Steel Structures Painting Manual, Vol. Two)
- HH. UL 580, - *Standard for Tests for Uplift Resistance of Roof Assemblies*.

1.5 DESIGN REQUIREMENTS

- A. The building shall be designed by the Manufacturer as a complete system. All components of the system shall be supplied or specified by the same manufacturer.

- B. Design Code: Design shall be in accordance with the listed building code on S-001 of the contract Drawings.
- C. Risk Category: II
- D. Dead Loads: The dead load shall be the weight of the Metal Building System and as determined by the system manufacturer.
- E. Collateral Loads: The collateral load shall be 5psf or as shown on the contract Drawings.
- F. Live Loads: The occupancy live loads are 100psf (recreational spaces) applied to the slab-on-grade and 30psf for the mezzanine (storage space).
- Roof Live Load: Uniform live load of 20psf, reducible per code.
- G. Snow Loads: The design roof snow loads shall be 15 psf. See the contract Drawings for more detailed information.
- H. Wind Loads: The nominal design wind speed for the Metal Building System shall be 90mph (increase as appropriate for LRFD structural design). The 10-year recurrence wind speed is 76mph and may be used for member deflection limits explicitly listed in paragraph 1.5.K. Reference the contract Drawings for more detailed information.
- I. Seismic Loads: Seismic loads shall be based on the following information:
Risk Category II ($I_e = 1.0$)
 $S_s = 0.614g$
 $S_1 = 0.185g$
Seismic Site Class = D
 $S_{DS} = 0.535g$
 $S_{D1} = 0.275g$
Seismic Design Category = D.
- J. Rainfall Intensity: All exterior gutters and downspouts shall be designed for rainfall intensity based upon a 5-year recurrence interval for a five-minute duration. All interior gutters, valleys and downspouts shall be designed for rainfall intensity based upon a 25-year recurrence interval based on five-minute duration.
- K. Unless explicitly listed otherwise below, deflection and drift requirements shall be in accordance with the applicable recommendations of the AISC *Steel Design Guide Series 3 – Serviceability Design Considerations for Steel Buildings*.
- Purlin and Rafters: Vertical deflection of 1/240 of the span for Live loads, 1/180 for Dead and Live loading combined.
 - Girts: Horizontal deflection of 1/120 of the span under 10-year recurrence wind loading.
 - Metal Roof Panels: Vertical deflection of 1/240 of the span for all Live loading types.
 - Metal Wall Panels: Horizontal deflection of 1/120 of the span under 10-year recurrence wind loading.
 - Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - Lateral Drift: Maximum of 1/400 of the building height (h) due to 10-year recurrence wind loading and 1/360 for gravity loading including Dead and Live Loads.

- Seismic Lateral Drift: Meet the requirements of ASCE 7 for system type.
- L. Thermal Effects: Standing Seam Roof Panels shall be free to move in response to the expansion and contraction forces resulting from a temperature variation. Assembly to permit movements of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 90 degrees F.

1.6 SUBMITTALS

- A. Reference Specification 01 33 00 for submittal procedures.
- B. Submit anchor rod placement plan, column reactions, in advance of erection drawings.
- C. Product Data: Provide data on profiles, component dimensions, fasteners, color selection, and performance characteristics.
- D. Manufacturer's Installation Instructions: Indicate preparation requirements, anchor bolt, anchor rod, and base plate locations, sizes, elevations, assembly sequence, and warranty.
- E. Shop or Erection Drawings: Indicate assembly dimensions, locations of structural members, connections, attachments, opening, cambers and loads; wall and roof system dimensions, panel layout, and load on foundation; general construction details, anchorages and method of anchorage, framing anchor rod settings, sizes, and locations from datum, and loads applied to the foundation system; indicate field welded connections with AWS A2.4 welding symbols; indicate net weld lengths; bearing the seal and signature of a Structural Engineer licensed in the state of Illinois.
- F. Letter of Design Certification: Signed and sealed by a qualified Structural Engineer licensed in the state of Illinois. Include the following:
1. Name and Location of Project.
 - Order Number.
 - Name of Manufacturer.
 - Name of Contractor.
 - Building dimensions including width, height, and roof slope.
 - Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - Governing building code and year of edition.
 - Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration.
 - Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - Building-Use Category: Indicate category of building use and its effect on load importance factors.
- G. Samples: Submit two samples of precoated metal panels for each color selected, 12"x12" in size illustration color and texture of finish.

1.7 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with MBMA *Metal Building Systems Manual*, and, for items not covered, AISC – *Specification for Structural Steel Buildings*.

1.8 QUALIFICATIONS

- A. Manufacturer: The company manufacturing the products specified in this Section shall have a minimum of three (3) years experience in the manufacture of metal building systems. The metal building systems manufacturer shall be accredited under the International accreditation Service, *Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems (AC472)*.
- B. Structural framing and covering shall be the design of a Registered Professional Engineer experienced in design of this work.
- C. Erector shall have specialized experience in the erection of steel building systems for a period of at least 3 years. Erector shall be accredited under the International Accreditation Service, *Accreditation Criteria for Inspection Practices of Metal Building Assemblers (AC478)*.

1.9 PRE-INSTALLATION MEETING

- A. Convene minimum one week prior to commencing work of this section.

1.10 FIELD MEASUREMENTS

- A. Metal building contractor shall verify that field measurements are as indicated on contract and erection drawings.

1.11 WARRANTY

- A. Furnish five-year manufacturer warranty for pre-engineered build systems and components.
- B. Metal building system manufacturer shall provide a “Premium” NDL (no dollar limit), single source, written weather-tightness warranty for a period of 20 years against leaks in roof panels, trim, flashing, and penetrations resulting from workmanship, ordinary wear and normal weather conditions. Warranty shall be signed by both the metal roof system manufacturer and the metal roof system installer.
- C. Metal building system manufacturer shall provide a written warranty for 25 years against perforation of metal roof panels due to corrosion under normal weather and atmospheric conditions. Warranty shall be signed by both the metal roof system manufacturer and the metal roof system installer.
- D. Metal building system manufacturer shall provide a paint film written warranty for 25 years against cracking, peeling, chalking and fading of exterior coating on painted roof and wall panels. Warranty shall be signed by metal building system or roof system manufacturer and state that coating contains 70 percent fluorocarbon resin paint. Metal building system manufacturer shall warrant that the coating shall not peel, crack or chip for 25 years. For a period of 25 years, chalking shall not exceed ASTM D4214, #8 rating and shall not fade more than 5 color difference units in accordance with ASTM D2244.

- E. Metal Building System Manufacturer's Certifications: Metal building system manufacturer shall submit a signed, written certification stating that the metal roof system manufacturer or approved representative will provide warranties and Inspection and Report Service specified in those specification section.

1.12 ADMINISTRATION

- A. All nomenclature shall conform to the MBMA Metal Building Systems Manual.
- B. Coordination and administration of the work shall be in accordance with the MBMA Metal Building Systems Manual – Chapter IV Common Industry.

PART 2 – PRODUCTS

2.1 PRE-ENGINEERED BUILDINGS

- A. Manufacturers:
 - A & S Building Systems.
 - American Steel Building Co.
 - Behlen Building Systems.
 - Butler Manufacturing Co.
 - Ceco Building Systems.
 - Chief Buildings.
 - Gulf States Manufacturers.
 - Inland Buildings.
 - Mesco Building Solutions.
 - NuCor Buildings Group.

2.2 COMPONENTS – WALL AND ROOF SYSTEMS

- A. Sheet Steel: ASTM A653; G90 Zinc coating or Galvalume AZ50.
- B. Joint Seal Gaskets: Manufacturer's standard type.
- C. Fasteners: Manufacturer's standard type, high performance organic coating, finish to match adjacent surfaces when exterior is exposed.
- D. Bituminous Paint: Asphaltic type.
- E. Sealant: Manufacturer's standard non-staining, elastomeric, skinning.
- F. Trim, Closure Pieces, Caps, Flashings, Rain Water Diverter, Facias and Infills: Same material, thickness and finished to manufacturer standard colors as selected by Architect/Engineer, brake formed to required profiles.
- G. Interior Liner Panels: flat profile with hidden fastener system.
- H. Insulation: Two layer, long tab banded system providing a continuous vapor barrier.

System shall consist of reinforced polyethylene liner/vapor barrier with unfaced fiberglass insulation layers to fill wall and roof cavities, supported with coated steel banding installed perpendicular at the underside of purlins and interior face of wall girts. Color of liner to be selected by A/E from manufacturers standard selection of colors.

1. Manufacturers:
 - a. CMI Specialty Insulation; High R-Value Banded System.
 - b. Owens Corning: Optiliner Banded Liner System.
 - c. ThermALL: Long Tab Banded System (FC).
 - d. Thermal Design Inc.: Simple Saver System.
2. Provide all accessories required for complete installation in accordance with the manufacturer's published installation instructions including vapor barrier tape, metal banding straps, thermal breaks, thermal spacer blocks, steel fasteners and insulation hangers.
3. Wall R-Values: R-19 in girts with R-11 and thermal spacer blocks as continuous insulation; Assembly U-Factor of 0.037.
4. Roof R-Values: R-25 in purlins with R-11 and thermal spacer blocks as continuous insulation; Assembly U-Factor of 0.031.

2.3 COMPONENTS – METAL DOORS AND FRAMES

- A. Doors: Specified in Section 08 11 13.
- B. Door Frames: Specified in Section 08 11 13.
- C. Coiling Door: Specified in Section 08 33 00.

2.4 COMPONENTS – WINDOWS

- A. Storefront Window System: Specified in Section 08 41 13.

2.5 COMPONENTS – RAKE/EAVE EXTENSIONS/CANOPIES

- A. Roof rake/eave extensions shall consist of cantilevered extension beams or roof purlins, 2'-0" beyond steel line, complete with all trim, closures, and all necessary flashing to provide a weather-tight overhang. Soffit panel is required for rake/eave extension.
- B. Canopies shall consist of roof panels supported by framing system per manufacturers recommendations, 6'-0" long, complete with trim, closures, and all necessary flashing to provide a weather-tight overhang. Soffit panel to be included, finished to manufacturer standard colors as selected by Architect/Engineer.

2.6 FABRICATION – FRAMING

- A. Fabricate members in accordance with AISC Specification for plate, bar, tube, or rolled structural shapes.
- B. General: Design components and field connections required for erection to permit easy assembly.
 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes

of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 - 1. Make shop connections by welding or by using high-strength bolts.
 - 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 - 3. Brace compression flange of primary framing with steel angles or cold- formed structural tubing between frame web and purling web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 - 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
 - 5. Shop Priming: Prepare surfaces for shop priming according to SSPC- SP2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 - 1. Make shop connections by welding or by using non-high-strength bolts.
 - 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC- SP2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Anchor Bolts: Assembled with template for casting into concrete.
- F. Provide framing for openings.

2.7 FABRICATION-WALL AND ROOF SYSTEMS

- A. Siding:
 - 1. Roll formed panels, 1 1/8-inch-high corrugations at 12 inches on center. AVP profile basis of design.
 - a. The exposed finish shall be 70 percent fluorocarbon resin paint over AZ50 Galvalume or G90 Zinc coating. Color as selected by the Architect/Engineer from the manufacturer's standard color selections.
 - 2. PAC – CLAD Highline S-1 panels, 24 gauge steel, to be used in accent areas. Refer to drawings for illustration. Color as selected by the Architect/Engineer from the manufacturer's standard color selections.
- B. Standing seam metal roofing panels to be the configuration shown on the Drawings, or as approved by the Architect/Engineer and factory fabricated from 24-gauge minimum material.
 - 1. The exposed finish shall be 70 percent fluorocarbon resin paint over AZ50 Galvalume or G90 Zinc coating. Color as selected by the Architect/Engineer from the manufacturer's standard color selections.
 - 2. Panels shall be interlocking with non-hardening factory applied seam sealant. Seams to be continuously locked for crimped mechanically during installation.

Note: Side lap joints and/or exposed structural fasteners are NOT allowed.
Panel end laps will NOT be allowed.

3. Panels shall be attached with concealed clip fasteners, spaced as required to provide for both positive and negative design loads while allowing for expansion and contraction of the entire roofing system resulting from annual variations in temperature. The standing seam roofing system shall be listed by Underwriter's Laboratories for wind uplift classification UL 90.
- C. Liner Panels: 24 gauge 1 inch metal thickness. Flat profile, male/female edges, with standard finish in color to be selected by the Architect/Engineer.
- D. Girts/Purlins: 8-inch deep "Z"-shaped, precision-roll-formed, acrylic-coated G30 galvanized steel to receive siding, and roofing sheets, in gauges required to meet specified loading conditions.
 1. G90 Zinc coated material is also an acceptable finish for girts and purlins.
- E. Sub-framing components supporting metal wall and roof systems shall be 16 gauge minimum thickness, quantity and spacing as required to meet specified design and performance requirements.
- F. Eave Struts: Factory punched "C" sections, precision-roll-formed, acrylic-coated G30 galvanized steel in gauges required to meet specified loading conditions.
 1. G90 Zinc coated material is also an acceptable finish for eave struts.
- G. Flashings, Closure Pieces, Fascia, Infills, Caps: Same material and finish as adjacent material, profile to suit system and formed as detailed.
- H. Fasteners: To maintain load requirements and weather-tight installation, same finish as cladding, non-corrosive type and finish.

2.8 FABRICATION – GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts of profile and size indicated to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths Hem exposed edges. Allow for expansion at joints.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.9 FACTORY FINISHING

- A. Framing Members: Clean, prepare, and galvanize to ASTM A123/A123M; galvanize after fabrication. Do not prime surfaces to be field welded.
- B. Galvanizing for Nuts, Bolts and Washers: ASTM A153/A153M.
- C. Interior Surfaces of Wall and Roof Components and Accessories: The exposed interior surface of roofing and siding components and accessories shall be pre-painted with 0.5

mil white polyester paint or pre-painted with a washcoat.

PART 3 – EXECUTION

3.1 EXECUTION

- A. Verify site conditions under provisions of Section 01 33 00 – Administrative requirements.
- B. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position and properly squared.
- C. Provide access to the work scheduled for owner provided inspections, if required. The cost of any required inspections is the responsibility of the owner.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 ERECTION – FRAMING

- A. Erect framing in accordance with *MBMA Metal Building Systems Manual, Chapter IV Common Industry Practices* and *AISC 303 Code of Standard Practice for Steel Buildings and Bridges*.
- B. Use templates for accurate setting of anchor rods. When required, level bearing plate area with steel wedges, shims or grout. Check all previously placed anchorages.
- C. Erect building frame true and level with vertical members plumb and bracing properly installed. Maintain structural stability of frame during erection.
- D. Ream holes requiring enlargement to admit bolts. Burned holes for bolted connections are not permitted without written approval by the Designer. Burned holes to be reamed.
- E. Tighten bolts and nuts in accordance with *RCSC Specification for Structural Joints Using High-Strength Bolts*, using specified procedure. Snug-tight or pretensioned joints are acceptable; for pre-tensioned, turn-of-the-nut tightening, calibrated wrench tightening, tension control (TC) bolts, or direct tension indicator washers may be used to assure correct tightening. Metal building Manufacture will specify joints requirements at each connection.
- F. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads, such as wind loads acting on the exposed framing and seismic forces, as well as loads due to erection and erection operation, but not including loads resulting from the performance of work by others. Bracing furnished by the manufacturer for the metal building system cannot be assumed to be adequate during erection and are not be used to pull frames into plumb condition.

The temporary guys, braces, falseworks and cribbing are the property of the erector, and the erector shall remove them immediately upon completion of the erection.

- G. Do not field cut or modify structural members with approval of the metal building manufacturer.
- H. After erection, erector to prime welds, abrasions, and surfaces that have not been shop primed or galvanized to allow either surface application to take place.

3.3 ERECTION – WALL AND ROOFING SYSTEMS

- A. Install all wall and roofing systems in accordance with manufacturer's instructions and details.
- B. Exercise care when cutting prefinished material to ensure cutting do not remain on finished surface.
- C. Fasten cladding system to structural supports, using proper fasteners aligned level and plumb.
- D. Set purlins and girts at right angle and bolt to appropriate clips. Attach to clips as required to satisfy design loads and as shown on Drawings.
- E. Place through-fastened roof panels at right angle to purlins and girts. Attach and plumb wall panels as shown on drawings. Maintain consistent module coverage for entire length of wall. For predrilled panels, lap panel ends 6 inches minimum on roof and 6 inches minimum on walls. Place end laps over purlins or girts. Apply manufacturer's roof panel side and end lap sealant between panel ends and side laps to provide water-tight installation per details furnished.
- F. Place Standing Seam Roof panels at right angle to purlins. Attach with sliding concealed clip where expansion and contraction must be accounted for. Lap panel ends as determined by manufacturer's standard and panel notch. Place end laps above purlin with backup plate and/or cinch strap so panel end-lap fasteners do not penetrate purlin. Follow manufacturer's instructions for fastening and sealing end laps.

3.4 ERECTION – GUTTER, DOWNSPOUT, FLASHINGS AND TRIM

- A. Install gutters and downspouts, flashings, and trim in strict accordance with manufacturer's instructions, using proper sheet metal procedures.
- B. Slope gutters minimum 1/8 inch per foot.
- C. Provide precast concrete splash block at each downspout not located over walks or paving. Secure rigidly in place/
- D. Provide underground connection with daylighting beyond walk or paving at each downspout located over walks or paving.
- E. Provide gutter expansion joints at max 50'0" spacing and as indicated on drawings.

3.5 ERECTION – ACCESSORIES

- A. Install door frame, door, coiling counter door, and storefront system, in accordance with

manufacturer's instructions.

- B. All roof and wall accessories shall be installed weathertight.

3.6 TOLERANCES

- A. All work shall be performed by experienced workman in a workmanlike manner to published tolerances.
- B. Install framing in accordance with MBMA *Metal Building Systems Manual, Chapter IV Common Industry Practices*.

END OF SECTION

SECTION 22 05 00 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Heating Contractor.
 - c. Air Conditioning and Ventilating Contractor.
 - d. Temperature Control Contractor.
 - e. Fire Protection Contractor.
 - f. Testing, Adjusting, and Balancing Contractor.
2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Makeup Air Units.
 - b. Package Air Handling Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
4. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.3 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Robinson, Illinois Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of Illinois Eastern Community Colleges .
3. Conform to all State Codes.
4. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.
5. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
6. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
7. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
8. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
9. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. Make application for and pay for service connections, such as sewer and water and gas.
4. Make application for and pay for all meters and metering systems required by the utility company.

F. Examination of Drawings:

1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.4 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

Referenced Specification	Submittal Item
Section 22 05 13	Motors

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
 - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.

- 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
- d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
 15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
- a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.

16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 22 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 22 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.5 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.

2. Change of subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.6 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.7 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.8 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.9 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.10 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the first manufacturer is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractor's part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - EXECUTION

2.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

2.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found at the following website (<https://call811.com/>) or by calling 811.
2. The Contractor shall do all excavating, filling, backfilling and compacting associated with the work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment, or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workers.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate, and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. Utilities Bedding: Lay underground utilities on minimum of 6" sand bedding. Compact bedding under utilities smooth, with no sharp edges protruding, to protect the utilities from puncture. Shape bedding to provide continuous support for bells, joints, and barrels of utilities and for joints and fittings.
2. Envelope around utilities to 6" above utilities: Place and compact sand to a height of 6" over utilities in 6" layers. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement. After connection joints are made, any misalignment can be corrected by tamping backfill around the utilities.
3. Backfill from 6" above utilities to earthen grade: Place all backfill materials above the utilities in uniform layers not exceeding 6" deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.
4. Backfill from 6" above utilities to below slabs or paved area: Where the fill and backfill will ultimately be under a building, floor or paving, each layer of backfill materials shall be compacted to 95% of the maximum density determined by AASHTO Designation T 99 or ASTM Designation D 698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T 99 or ASTM D 698 test.
5. Backfill Materials: Native soil materials may be used as backfill if approved by the Geotechnical Engineer. Backfill material shall be free of rock or gravel larger than 3" in any dimension and shall be free of debris, waste, frozen materials, vegetation, high void content, and other deleterious materials. Water shall not be permitted to rise in unbackfilled trenches.
6. Dispose of excess excavated earth as directed.
7. Backfill all trenches and excavations immediately after installing utilities or removal of forms, unless other protection is provided.
8. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.

F. Surface Restoration:

1. Where trenches are cut through existing graded, planted, or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

2.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. Pipe insulation is installed and fully sealed.
 - b. Pipe wall penetrations are sealed.
 - c. Pipe identification and valve tags are installed.
2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

2.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.
3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including marked-up drawings and specifications.
3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
4. Start-up reports on all equipment requiring a factory installation inspection or start-up.

5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

2.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div22.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div22.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.
16. Owner and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

2.6 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- C. The instructions shall include:
 1. Explanation of all system flow diagrams.
 2. Maintenance of equipment.
 3. Start-up procedures for all major equipment.
 4. Explanation of seasonal system changes.
 5. Explanation of Owner's Responsibilities to operate, maintain, and flush domestic water system (i.e., ASHRAE Standard 188).
- D. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.

- E. Minimum hours of instruction for each item shall be:
 - 1. Domestic Hot Water System - 4 hours
 - 2. All Domestic Water Systems operation, maintenance and flushing of all fixtures and dead legs - 4 hours

- F. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.

- G. Operating Instructions:
 - 1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.
 - 2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

2.7 SYSTEM STARTING AND ADJUSTING

- A. The plumbing systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.

- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.

- C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

2.8 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of plumbing drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.
- D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- E. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

2.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed piping, hangers, and accessories.
- D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

2.10 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled and valves tagged.
5. Owner and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

END OF SECTION

SECTION 22 05 13 - MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Phase and Three Phase Electric Motors.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 22 05 00. Include nominal efficiency and power factor for all premium efficiency motors. Efficiencies must meet or exceed the nominal energy efficiency levels presented below.
- B. Submit shop drawings for all three phase motors.
- C. Submit motor data with equipment when motor is installed by the manufacturer at the factory.
- D. Submit shaft grounding rings or brushes or ceramic bearings for all motors as required.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Refer to the drawings for required electrical characteristics. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115

208	200
240	230
277	265
480	460

- B. Design motors for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.
- D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- E. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.
- F. Each contractor shall set all motors furnished by him.
- G. All motors shall have a minimum service factor of 1.15.
- H. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.
- I. Aluminum end housings are not permitted on motors 15 HP or larger.
- J. Motor Driven Equipment:
 - 1. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.
 - 2. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.
- K. Motors for pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control.

2.2 ELECTRICALLY COMMUTATED MOTORS (ECM)

- A. Motor shall be variable speed, constant torque, brushless DC motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall integral surge protection. Motor shall be pre-wired for specific voltage and phase.

- B. Motor frame shall be NEMA 48; UL recognized components shall be provided for the motor construction.
- C. All EC motors shall be a minimum of 85% efficient at all speeds.
- D. Motors shall be permanently lubricated; utilize ball bearings to match with the connected driven equipment.
- E. Provide motor with onboard motor control module. Motor speed shall be limited to provide electronic over current protection. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed.
- F. Operational mode shall be as scheduled and shall be one of the following:
 - 1. Constant Flow
 - 2. Constant Temperature
 - 3. Constant Pressure

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.
- B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.

END OF SECTION

SECTION 22 05 29 - PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

- A. Refer to Section 22 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2-1/2" and smaller	3/8"	3/8"
3" through 3-5/8"	3/8"	3/8"
4" and 5"	1/2"	1/2"

Column #1: Steel, cast iron, and glass pipe.

Column #2: Copper and plastic pipe.

Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

- B. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

- C. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

2.3 PIPE AND STRUCTURAL SUPPORTS

A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).
2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.
3. Copper piping located in an exposed area, including indirect waste piping in janitor's closets, shall use split ring standoff hangers for copper tubing. Support shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

a. Products:

- 1) Erico/M-Co Model #456
- 2) B-Line Fig. 3198HCT
- 3) Anvil Fig. CT138R
- 4) Nibco/Tolco Fig. 301CT

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

a. Products:

- 1) Cooper/B-Line Fig B3373 Series
- 2) Erico 510 Series
- 3) Nibco/Tolco Fig. 82

2. Cold Pipe: Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.

a. Products:

- 1) Mason RBA, RCA or RDA
- 2) Mason BR

3. Cold Pipe Alternative: Insulated pipe riser clamp with no thermal bridging between clamp and pipe; water repellant calcium silicate insulation material adhered inside the clamp; ASTM A653 galvanized steel clamp.

a. Products:

- 1) Pipeshields E100

4. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp within their temperature limits of -65°F to +275°F.
3. Vertical cold pipe drops and rough-ins to fixtures shall be supported by insulated pipe clamps to prevent thermal bridging and condensation.
4. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
5. Unless otherwise indicated, hangers shall be as follows:

a. Clevis Type:

- 1) Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches & Smaller
- 2) Products: Bare Steel Plastic or Insulated Pipe:
 - a) Anvil Fig. 260
 - b) Cooper/B-Line Fig. 3100
 - c) Erico Model 400
 - d) Nibco/Tolco Fig. 1
- 3) Products: Bare Copper Pipe:
 - a) Cooper/B-Line Fig. B3100C
 - b) Nibco/Tolco Fig. 81PVC

- b. Adjustable Swivel Ring Type:
 - 1) Service: Bare Metal Pipe - 4 inches and Smaller
 - 2) Bare Steel Pipe:
 - a) Anvil Fig. 69
 - b) Cooper/B-Line Fig. B3170NF
 - c) Erico Model FCN
 - d) Nibco/Tolco Fig. 200
 - 3) Bare Copper Pipe:
 - a) Cooper/B-Line Fig. B3170CTC
 - b) Erico 102A0 Series
 - c) Nibco/Tolco Fig. 203
- 6. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.
 - a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
 - b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.
- 7. Unless otherwise indicated, pipe supports for use with struts shall be as follows:
 - a. Clamp Type:
 - 1) Service: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches and smaller
 - 2) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.
 - 3) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.
 - 4) Bare Steel, Plastic or Insulated Pipe:
 - a) Unistrut Fig. P1100 or P2500
 - b) Cooper/B-Line Fig. B2000 or B2400
 - c) Nibco/Tolco Fig. A-14 or 2STR
 - 5) Bare Copper Pipe:
 - a) Cooper/B-Line Fig. BVT

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
 - a. Steel Structure Clamps: C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):
 - 1) Products:
 - a) Anvil Fig. 92
 - b) Cooper/B-Line Fig. B3033/B3034
 - c) Erico Model 300
 - d) Nibco/Tolco 68
 - b. Steel Structure Clamps: Scissor Type Beam Clamps (for use with bar-joists and wide flange):
 - 1) Products:
 - a) Anvil Fig. 228, 292
 - b) Cooper/B-Line Fig. B3054
 - c) Erico Model 360
 - d) Nibco/Tolco Fig. 329
 - c. Concentrically Loaded Open Web Joist Hangers (for use with bar joists):
 - 1) Products:
 - a) MCL. M1, M2 or M3
 - d. Steel Structure Welding:
 - 1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 22 05 50 for additional requirements for concrete bases in seismic applications.
2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).
3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".
4. Concrete materials and workmanship required for the Contractor's work shall be provided by the Contractor. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6"x6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.
5. Equipment requiring bases is as follows:
 - a. Water Heater

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.

- E. Do not cut structural members without written approval of the Architect or Structural Engineer.
- F. Exposed Housing Penetrations: Seal pipes with surface temperature below 150°F, penetrating housings with conical stepped, white silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite.

2.6 ROOF PENETRATIONS

- A. Roof Curb Enclosure: Provide weatherproof roof curb and enclosure for pipe penetrations. Refer to drawings for details.
- B. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.7 SLEEVES AND LINTELS

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.8 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.9 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.10 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.11 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 PLUMBING SUPPORTS AND ANCHORS

- A. General Installation Requirements:
 - 1. Install all items per manufacturer's instructions.
 - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
 - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
 - 4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with sheet metal contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
2. Set all concrete inserts in place before pouring concrete.
3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
 - a. The hanger is attached within 6" from a web/chord joint.
 - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Steel/Concrete Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:
 - 1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" & under: 7'-0"
 - 2) 1-1/2": 9'-0"
 - 3) 2": 10'-0"
 - 4) 2-1/2": 11'-0"
 - 5) 3": 12'-0"
 - 6) 4" & larger: 12'-0"
 - 2. Steel (Std. Weight or Heavier - Vapor Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" and under: 9'-0"
 - 2) 1-1/2": 12'-0"
 - 3) 2" & larger: 12'-0"
 - 3. Hard Drawn Copper & Brass (Liquid Service):
 - a. Maximum Spacing:
 - 1) 3/4" and under: 5'-0"
 - 2) 1": 6'-0"
 - 3) 1-1/4": 7'-0"
 - 4) 1-1/2" 8'-0"
 - 5) 2": 8'-0"
 - 6) 2-1/2": 9'-0"
 - 7) 3": 10'-0"
 - 8) 4": 12'-0"
 - 9) 6": 12'-0"

4. Hard Drawn Copper & Brass (Vapor Service):

a. Maximum Spacing:

- 1) 3/4" & under: 7'-0"
- 2) 1": 8'-0"
- 3) 1-1/4": 9'-0"
- 4) 1-1/2": 10'-0"
- 5) 2": 11'-0"
- 6) 2-1/2" & larger: 12'-0"

5. Plastic Pipe:

- a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.

- I. Installation of hangers shall conform to MSS SP-58, 69, 89 and the applicable Plumbing Code.

END OF SECTION

SECTION 22 05 50 - SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Seismic Requirements.

1.2 QUALITY ASSURANCE

A. General:

1. The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint and support system and perform seismic calculations in accordance with these specifications, state, and local codes.
2. Items used for seismic restraint of equipment and systems shall be specifically manufactured for seismic restraint.
3. These requirements are beyond those listed in Section 22 05 29 of these specifications. Where a conflict arises between the seismic requirements of this section and any other section, the Architect/Engineer shall be immediately notified for direction to proceed.

B. Manufacturer:

1. System Supports/Restraints: Company specializing in the manufacture of products specified in this Section.
2. Equipment: Each company providing equipment that must meet seismic requirements shall provide certification included in project submittals the equipment supplied for the project meets or exceeds the seismic requirements of the project.

- C. Testing Agency: An independent testing agency, acceptable to Authorities Having Jurisdiction, with experience and capability to conduct the testing indicated.

- D. Installer: Company specializing in performing the work of this Section.

1.3 SUBMITTALS

A. Shop Drawings:

1. Calculations, restraint selections, and installation details shall be designed and sealed by a Professional Engineer licensed in the state where the project is located experienced in seismic restraint design and installation.
2. Coordination Drawings: Plans and sections drawn to scale, coordinating seismic bracing of mechanical components with other systems and equipment in the vicinity, including other seismic restraints.
3. Manufacturer's Certifications: Professional Engineer licensed in the state where the project is located shall review and approve manufacturer's certifications of compliance.

4. System Supports/Restraints - Submit for each condition requiring seismic bracing:
 - a. Calculations for each seismic brace and detail utilized on the project.
 - b. Plan drawings showing locations and types of seismic braces on contractor fabrication/installation drawings.
 - c. Cross-reference between details and plan drawings to indicate exactly which brace is being installed at each location. Details provided are to clearly indicate attachments to structure, correctly representing the fastening requirements of bracing.
 - d. Clear indication of brace design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.

5. Equipment - Submit for each piece of equipment supplied:
 - a. Certification that the equipment supplied for the project meets or exceeds the seismic requirements specified.
 - b. Specific details of seismic design features of equipment and maximum seismic loads imparted to the structural support.
 - c. Engineering calculations and details for equipment anchorage and support structure.

1.4 TESTING AND INSPECTION

- A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the International Building Code.
- B. The Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.
- C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.
- D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

1.6 DESIGN REQUIREMENTS

- A. This project is subject to the seismic bracing requirements of the International Building Code, 2021 edition.
- B. The following criteria are applicable to this project:
 - 1. Risk Category: II
 - 2. Seismic Design Category: D
 - 3. Component Amplification Factors (ap) and Component Response Modification Factors (Rp) shall be taken from Table 13.5-1 in ASCE 7-16 for the individual equipment or system being restrained.
 - 4. Component Importance Factors (Ip) shall be taken from Section 13.1.3 in ASCE 7-16 for the individual equipment or system being restrained.
 - 5. The total height of the structure and the height of the system to be restrained within the structure shall be determined in coordination with architectural plans and the General Contractor.
- C. Forces shall be calculated with the above requirements and Equations 13.3-1, -2, and -3 of ASCE 7-16, unless exempted by 13.1.4.
- D. Equipment shall meet International Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

1.7 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

1.8 WARRANTY

- A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

PART 2 - PRODUCTS

2.1 SUPPLIERS

- A. Following is a partial list of manufacturer/supplier contact information for seismic restraints:
 - 1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.
 - 2. Unistrut Corporation <http://www.unistrut.us/>
 - 3. Kinetics Noise Control (877) 457-2695, www.kineticsnoise.com.
 - 4. Mason Industries, Inc. www.mason-ind.com.

5. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.
6. Tolco (909) 737-5599, www.tolco.com
7. ISAT 877.523.6060, www.isatsb.com
8. Vibro-Acoustics (416) 291-7371, <https://virs.vibro-acoustics.com/>

2.2 SEISMIC DESIGN CRITERIA

- A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.
- B. Definitions:
 1. Stay in Place:
 - a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.
 2. Remain Operational:
 - a. Requirements for "Stay in Place" listed above shall be met.
 - b. The following systems and associated equipment are intended not to fail externally or internally and are intended to continue operation following a seismic event:
 - 1) Plumbing

2.3 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
 1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.
 2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.
 3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.
 5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.
 6. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.
- B. Friction from gravity loads shall not be considered resistance to seismic forces.

C. Housekeeping Pads:

1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

2.4 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

- A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.
- B. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:
 1. Pumps
 2. Tanks

2.5 MATERIALS

- A. Use the following materials for restraints:
 1. Indoor Dry Locations: Steel, zinc plated.
 2. Outdoors and Damp Locations: Galvanized steel.
 3. Corrosive Locations: Stainless steel.

2.6 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.7 SEISMIC BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
 - 1. Materials for Channel: ASTM A 1011, GR 33.
 - 2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.
 - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
 - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
 - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
 - 2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.
- B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.
- C. All rigid floor mounted equipment shall have a resilient media between the equipment mounting hole and the anchor bolt in concrete.
- D. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- E. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.

- F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
- G. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
- H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.
- I. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.
- K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.
- L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.
- M. Do not install cables over sharp corners.
- N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.
- O. Provide reinforced clevis bolts when required.
- P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.
- Q. Post-Installed anchors shall be provided to meet seismic requirements.
- R. Vertical pipe risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.
- S. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
- T. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent piping.

- U. Water tanks shall be secured to their saddles by welding or proper concrete attachment, and those saddles shall be properly attached to the structure.
- V. Independently brace duct mounted equipment (terminal units, in-line fans, etc.) and the associated suspended ductwork.
- W. Do not brace a system to two different structures such as a wall and a ceiling.
- X. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- Y. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.
- Z. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.
- AA. Coordinate seismic bracing of architecturally exposed ductwork with the Architect/Engineer.

3.2 SEISMIC RESTRAINT EXCLUSIONS

- A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

END OF SECTION

SECTION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 22.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 MATERIALS

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or Insulation	Marker Length	Size of Letters
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"

Plastic tags may be used for outside diameters under 3/4"

- B. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- C. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.
- D. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.
- E. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferrous metal detectors and bold lettering identifying buried item.
- F. Tracer Wire:
 - 1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.
 - 2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.
 - 3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
 - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
 - 2. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
 - 3. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
 - 4. Number all tags and show the service of the pipe.
 - 5. Provide two sets of laminated 8-1/2" x 11" (letter size) copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.
- D. Pipe Markers:
 - 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
 - 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
 - 3. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 20 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least once in every room and each story traversed.
 - 4. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.
- E. Equipment:
 - 1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.
2. Tracer wire shall be taped directly to plastic water or drain pipe.
3. Tracer wire shall not be fastened directly or indirectly to gas piping.
4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.
5. Tape shall be Polyken "930-35", Protecto-Wrap "310", or approved equal.
6. Tracer wire shall be continuous between boxes and shall be tested for continuity.
7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. Wire nuts shall not be used.
8. The tracer wire shall daylight to grade through a 2" PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:

1. CONDENSATE DRAIN: White lettering; green background
2. DOMESTIC COLD WATER: White lettering; green background
3. DOMESTIC HOT WATER - 140°F: White lettering; green background
4. DOMESTIC HOT WATER CIRCULATING - 140°F: White lettering; green background
5. SANITARY SEWER: Black lettering; yellow background
6. VENT: Black lettering; yellow background
7. NATURAL GAS: Black lettering; yellow background
8. All Underground Pipes: Varies
9. Tracer Wire - Natural Gas Pipe Lines: Black lettering; yellow background
10. Tracer Wire - All other buried types: White lettering; green background

B. Non-Potable Piping: All piping conveying non-potable water shall be permanently identified by continuously painted or continuous adhesive backed marker along entire length of pipe and branches so the piping is readily distinguishable from piping carrying potable water. Pipe markers shall be located as described above.

1. NON-POTABLE WATER: White lettering; purple background

END OF SECTION

SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
- B. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534 Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75°F, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.

- C. Type E: Preformed rigid cellular polyisocyanurate insulation; ANSI/ASTM C591; maximum 'K' value of 0.19 at 75°F; density 4.0lb/ft; minimum compressive strength 95 psi parallel to rise; moisture resistant; listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code; suitable for -297°F to +300°F.

2.2 VAPOR BARRIER JACKETS

- A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.
- B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

2.3 JACKET COVERINGS

- A. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. Listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

- A. General Installation Requirements:
 - 1. Install materials per manufacturer's instructions, building codes and industry standards.
 - 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
- B. Insulated Piping Operating Below 60°F:
 - 1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
 - 2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
 - 3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.
- C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140°F:

1. Insulate fittings, valves, flanges, and strainers.
2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.

E. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.
3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping shall be insulated unless local code allows it to be uninsulated. In no instance should the uninsulated portion of the piping be more than 4ft in developed length.

3.3 SUPPORT PROTECTION

- A. Provide a shield on all insulated piping at each support between the insulation jacket and the support.

- B. On all insulated piping greater than 1-1/2", provide shield with insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:

1. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180° cylindrical segment the same length as metal shields. Inserts shall be:
 - a. Polyisocyanurate insulation (for pipes below 300°F with a minimum compressive strength of 24 psi is acceptable for pipe sizes 3" and below, minimum 60 psi for pipe sizes 4" to 10". For pipe sizes larger than 10", provide rolled steel plate in addition to the shield. Where insulation is installed on piping located within return air plenums and mechanical rooms, insulation shall be listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
 - b. As an alternative to separate pipe insulation insert and saddle, properly sized manufactured integral rigid insulation insert and shield assemblies may be used.

1) Products:

- a) Buckaroo CoolDry
- b) Cooper/B-Line Fig. B3380 through B3384
- c) Pipe Shields A1000, A2000

c. Insulation Couplings:

- 1) Molded thermoplastic slip coupling, -65°F to 275°F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.
- 2) Horizontal Strut Mounted Insulated Pipe Manufacturers:
 - a) Klo-Shure or equal
- 3) Vertical:
 - a) Manufacturers: Klo-Shure Titan or equal

d. Rectangular blocks, plugs, or wood material are not acceptable.

e. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.

C. Neatly finish insulation at supports, protrusions, and interruptions.

D. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

E. Shields shall be at least the following lengths and gauges:

<u>Pipe Size</u>	<u>Shield Size</u>
1/2" to 3-1/2"	12" long x 18 gauge
4"	12" long x 16 gauge

F. Minimum 1/4" rolled galvanized steel plates shall be provided in addition to the sleeves as reinforcement on large pipes to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength. Refer to section above for exact locations.

3.4 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.

4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Install per manufacturer's instructions or ASTM C1710.
2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
3. Insulation Installation on Straight Pipes and Tubes:
 - a. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - b. Insulation must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

C. Type E Insulation:

1. Indoors, above grade or below grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer's recommendations for installation guidelines.
2. Insulate pipe fittings with prefabricated insulation fittings.

3.5 JACKET COVER INSTALLATION

A. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.

3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. Use plastic insulation covering on all exposed pipes including, but not limited to:
 - a. All exposed piping in locker rooms.
 - b. All exposed piping below 8'-0" above floor.
 - c. All piping in mechanical rooms and/or tunnels that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
5. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.

3.6 SCHEDULE

- A. Refer to drawings for insulation schedule.

END OF SECTION

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Check Valves.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.
- D. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 CAST IRON PIPE

- A. Cast Iron; Standard Weight; No-Hub Sleeve Gaskets:
 - 1. Pipe: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 and CISPI Trademark.
 - 2. Design Pressure: Gravity Maximum Design Temperature: 180°F

3. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.
4. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 310. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.
5. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

2.2 COPPER PIPE

A. Copper Pipe; Type L; Solder Joints:

1. Pipe: Type L hard drawn seamless copper tube, ASTM B88.
2. Design Pressure: 175 psi; Maximum Design Temperature: 200°F.
3. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
4. Fittings: Wrought copper solder joint, ANSI B16.22.

B. Copper Pipe; Type K; Solder Joints:

1. Pipe: Type K annealed copper tube, ASTM B88.
2. Design Pressure: 150 psi. Maximum Design Temperature: 200°F.
3. Joints: Solder with 100% lead-free solder and flux ASTM B32BCuP silver braze, AWS A5.8.
4. Fittings: Wrought copper solder joint, ANSI B16.22.

2.3 PLASTIC PIPE

A. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints:

1. Pipe: Schedule 40 rigid, PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.
2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.
3. Fittings: PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket type ends for Schedule 40 pipe.
4. Limits: Schedule 40 PVC-DWV, or ABS-DWV pipe must not be threaded. Do not use where exposed or in return air plenums.
5. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.
6. Special Requirements: Provide expansion loop(s) and/or expansion joints in the piping system per the manufacturer's guidelines and as shown on the drawings. Refer to Section 22 05 16 for expansion joint requirements.

2.4 VALVES

A. Shutoff Valves:

1. Gate Valves:
 - a. GA-2: 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi CWP @ 150°F, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, Nibco F-617-0.
 - b. GA-7: 2-1/2" thru 12", 200# CWP @ 150°F, flanged, iron body, bronze trim, OS&Y. Crane #475-1/2, Hammond #IR1146, Stockham #G624, Walworth #8727F, Milwaukee #F2891, Nibco F-617-0.

2. Ball Valves:
 - a. BA-1: 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.
 - 1) Provide solid extended shaft for all insulated piping.
 - 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.
 - b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi CWP ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Stockham #3951-CS-R-66-LL, Nibco #F510-CS/66, Milwaukee #F90.
 - 1) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.
 - c. BA-9: 2" and under, 150 psi saturated steam, 600 psi CWP, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless steel ball, Teflon seats and seals with memory stop. Apollo #70-120, Stockham #S-255-FB-P-UL, Milwaukee #BA-100, Watts #B-6000, Hammond #8501, Nibco #580-70.
 - 1) Provide solid extended shaft for all valves in insulated piping.
 - d. BA-11: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece "T" style cap and stem. A.Y. McDonald 6100 Series, Mueller 300 Series.

- e. BA-12: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece "T" style cap and stem. Minneapolis Pattern threaded top. A.Y. McDonald 6100 Series, Mueller 300 Series.

2.5 STRAINERS

- A. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi CWP @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777.

2.6 CHECK VALVES

- A. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.

2.7 VALVE BOX/CURB BOX

- A. VB-1: 2" and under, extension type curb box with arch pattern base and sufficient length to allow top to terminate flush with finished grade. Cast iron lid with integrally cast brass bushing and marked "water" in integrally cast raised letters. Furnished with valve operating wrench of sufficient length to extend 3' above finished grade when engaged with valve. Construction of curb box shall meet all local codes and requirements. Mueller H-10000 Series, A.Y. McDonald 5600 Series, Tyler Pipe 6500 Series.
- B. VB-2: 2" and under, extension type curb box with Minneapolis pattern base and sufficient length to allow top to terminate flush with finished grade. Cast iron lid with integrally cast brass bushing and marked "water" in integrally cast raised letters. Furnished with valve operating wrench of sufficient length to extend 3' above finished grade when engaged with valve. Construction of curb box shall meet all local codes and requirements. Mueller H-10000 Series, A.Y. McDonald 5600 Series.
- C. VB-3: 3" through 12", extension type valve box with flat base, 5-1/4" shaft and sufficient length to allow top to terminate flush with finished grade. Cast iron lid marked "water" in integrally cast letters. Furnished with valve operating wrench of sufficient length to extend 3' above finished grade when engaged with valve. Construction of curb box shall meet all local codes and requirements. Tyler Pipe 6855 Series.

2.8 VALVE OPERATORS

- A. Provide handwheels for gate valves and gear operators for butterfly valves.

2.9 VALVE CONNECTIONS

- A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

2.10 CONNECTIONS BETWEEN DISSIMILAR METALS

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.
- C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel and stainless steel are commonly used and require isolation from each other with the following exceptions:
 - 1. Iron and steel connected to each other.
 - 2. Brass, copper, and bronze connected to each other.
 - 3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.
- E. Screwed Joints (acceptable up to 2" size):
 - 1. Dielectric waterway rated for 300 psi CWP and 225°F.
 - 2. Manufacturers:
 - a. Elster Group ClearFlow fittings
 - b. Victaulic Series 647
 - c. Grinnell Series 407
 - d. Matco-Norca
- F. Flanged Joints (any size):
 - 1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
 - 2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
 - 3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
 - 4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
 - 5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
 - 6. Manufacturers:
 - a. EPCO
 - b. Central Plastics

- c. Pipeline Seal and Insulator
- d. F. H. Maloney
- e. Calpico

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install all products per manufacturer's recommendations.
- B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
- E. Connect to equipment with flanges or unions.
- F. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for dishwasher drainage or piping that receives boiler blowdown.
- G. Roof Penetration (Vent) Flashing:
 - 1. Built-up Roofing: Flash vents with 3# seamless sheet lead of sufficient size to extend 15" into roofing felts for built-up roofs.
 - 2. Membrane, Metal or Shingled Roofs: Flash vents with premolded pipe flashing cones for single-ply membrane roofs, metal roofs, or shingled roofs.
- H. Existing building sewers or building drains which are shown on the documents to be reused shall be inspected and recorded by closed circuit television for their condition. Report findings back to the Architect, Engineer, and Owner before proceeding with work so any necessary rework can take place if needed.

3.2 SYSTEM, PIPING AND VALVE SCHEDULE

- A. Cold Water, Hot Water, Tempered Water - Potable and Non-Potable (Above Ground):
 - 1. Copper Pipe; Type L; Solder Joints: All Sizes
 - 2. Shutoff Valves: BA-1
 - 3. Check Valves: CK-1
 - 4. Strainers: ST-1
- B. Cold Water, Hot Water, Tempered Water - Potable and Non-Potable (Underground):
 - 1. Copper Pipe; Type K; Solder Joints: All Sizes
- C. Sanitary Waste and Vent, Gravity (Above Ground):

1. Cast Iron; Standard Weight; No-Hub Sleeve Gaskets: 1-1/2" to 15"
2. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints: All Sizes

D. Sanitary Indirect Drainage (Above Ground):

1. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints: All Sizes

E. Sanitary Waste and Vent, Gravity (Underground - Inside Building):

1. PVC-DWV or ABS-DWV; Schedule 40; Solvent Weld Joints: All Sizes

F. Kitchen Grease Drainage and Vent:

1. Cast Iron; Standard Weight Epoxy Coated; No-Hub Sleeve Gaskets: 1-1/2" to 15"

3.3 TESTING PIPING

A. Sanitary Drainage, Sanitary Vent:

1. Test all piping with water to prove tight.
2. Test piping before insulation is applied.
3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.
4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.
5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception: Smoke/air test shall not be performed on plastic piping.
6. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.
7. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.

B. All Other Piping:

1. Test piping at 150% of normal operating pressure.
2. Piping shall hold this pressure for one hour with no drop in pressure.
3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.
4. Drain and clean all piping after testing is complete.

3.4 CLEANING PIPING

A. Assembly:

1. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.

2. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative regarding specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.
3. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.

B. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.
2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.
3. If necessary, remove valves to clean out all foreign material.

3.5 INSTALLATION

A. General Installation Requirements:

1. Provide dielectric connections between dissimilar metals.
2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.
5. Slope water piping and arrange to drain at low points.
6. Install bell and spigot piping with bells upstream.
7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.
2. Provide clearance for installation of insulation and access to valves and fittings.

3. Provide access doors for concealed valves and fittings.
4. Install valve stems upright or horizontal, not inverted.
5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.
6. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

D. Underground Piping:

1. Install buried water piping outside the building with at least insert 5 feet of cover. Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements
2. Install buried borosilicate glass pipe with the protective polystyrene covering intact. Lay the pipe on bedding and backfill per manufacturer instructions.
3. Underground fire protection service piping shall have at least insert 6-1/2 feet of cover, or as recommended by NFPA 24.
4. Install thrust blocking and restraints on all underground fire protection service piping per NFPA 24 and as shown on drawings.
5. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.
6. Direct buried, uninsulated steel pipe shall have a factory applied external protective coating consisting of two coats with an intermediate layer of 18 mil fibrous glass mat. Coating thickness shall total not less than 3/32". The outer coating shall be further protected by a wrapping of heavy Kraft paper. This external protection shall extend and be exposed for a minimum of 1 foot beyond the buried or concealed portion of the pipe.

a. Manufacturers:

- 1) Pipe Line Service Co., Franklin Park, Illinois
- 2) Lithcote Corp., Melrose Park, Illinois

7. As an option, the Contractor may provide factory applied protective coatings consisting of a polyethylene plastic film bonded to the pipe surface by a hot applied thermo-plastic adhesive.

a. Manufacturers:

- 1) Republic Steel Corp. "X-Tru-Coat"

8. Exercise care in handling, storing and laying pipe to avoid damaging factory applied coatings. If any damage occurs, repair the coating to a condition equal to the original.
9. Field application of protective coatings to joints, fittings and to any damaged factory applied coatings shall be similar to factory applied coatings specified above and shall be done in strict accordance with recommendations of the supplier of pipe coatings.
10. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.

11. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

E. Sanitary and Storm Piping:

1. Install all sanitary and storm piping inside the building with a slope as shown on the drawings.
2. Install horizontal offset at all connections to roof drains to allow for pipe expansion.
3. Slope sanitary and storm piping outside the building to meet invert elevations shown on drawings and to maintain a minimum velocity of 2 feet per second.
4. Sway Bracing: Where horizontal sanitary and/or storm pipes 4 inches and larger change flow direction greater than 45°, rigid bracing or thrust restraints shall be installed to resist movement of the upstream pipe in the direction of pipe flow. The rigid bracing or thrust restraint shall be connected to structure. A change of flow direction from horizontal into a vertical pipe does not require the upstream pipe to be braced.
5. All sanitary and storm piping shall have at least 42" of cover when leaving the building.
6. Starter fittings with internal baffles are not permitted.

3.6 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.
- B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.
- D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.
- E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.
- F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- G. Provide flanges or unions at all final connections to equipment, traps and valves.
- H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.

- I. Use full and double lengths of pipe wherever possible.
- J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.
- K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements.
- M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45° or 90° angle from the horizontal plane for air lines, and from top, bottom or side for liquids.
- N. Do not use geotextile fabric with footing tile if silt content of soil exceeds 40% or if clay content exceeds 50%. The fabric shall be installed around 1" river rock or 2" limestone.

3.7 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal water lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.
- B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.
- C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.
- D. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.
- E. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.
- F. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.
- G. All vent and drain piping shall be of same materials and construction for the service involved.

3.8 PLUMBING VENTS

- A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.
- B. Extend the high side of the soil and waste stacks at least 12" above roof.

- C. Flash pipes at the roof with 3# lead sheet. Extend flashing under roofing 15" in all directions from pipe to be flashed. Extend a lead collar up on the outside of pipe to be flashed and extend 1" beyond the top of the pipe. The 1" excess length of collar shall be turned down into the top of the pipe where it shall fit tight to the inside of the pipe.
- D. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.
- E. In no case shall the vent through the roof be less than 4" in diameter.
- F. Vent pipes through the roof shall be located a minimum of 10 feet from any air intake opening on the roof.

3.9 BRANCH CONNECTIONS

- A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.
- B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.
- D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:
 1. Domestic water piping above ground.
- E. Further limit use of mechanically formed fittings as follows:
 1. Must have at least same pressure rating as the main.
 2. Main must be Type K or L copper tubing.
 3. Permanent marking shall indicate insertion depth and orientation.
 4. Branch pipe shall conform to the inner curve of the piping main.
 5. Main must be 1" or larger.
 6. Branch must be 3/4" or larger.
- F. Branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.
- G. Forged weld-on fittings are limited as follows:
 1. Must have at least same pressure rating as the main.
 2. Main must be 2-1/2" or larger.
 3. Branch line is at least two pipe sizes under main size.

3.10 JOINING OF PIPE

A. Solder Joints (Copper Pipe):

1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
2. Flux shall be non-acid type.
3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove discs and seals during soldering if they are not suitable for 470°F.

B. Solvent Weld Joints (PVC):

1. Make joints with a two-step process. Use primer conforming to ASTM F656 and solvent cement conforming to ASTM D2564.

C. No-Hub Sleeve Gaskets (No-Hub) (Cast Iron Pipe):

1. Gasket shall be heavy weight class, conforming to ASTM C564.
2. The gasket shall have an internal center stop.
3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.
4. Sleeve gaskets shall be installed in accordance with the manufacturer's installation instructions.

3.11 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfection of the domestic water piping shall be completed within three (3) weeks prior to building occupancy. Contractor is responsible for disinfecting water piping if used by workers during construction; disinfection during construction does not eliminate the requirement for final disinfection prior to occupancy. Flushing of piping shall be completed within two (2) weeks prior to building occupancy.
- B. Provide necessary connections at the start of individual sections of mains for adding chlorine.
- C. Before starting work, verify system is complete, flushed and clean.
- D. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- E. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- F. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.

- G. Verify initial chlorination levels by testing at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main.
- H. Maintain disinfectant in system for 24 hours, after which test at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main. If final disinfectant residual tests less than 25 mg/L at any one of the tested outlets, flush the entire system and repeat disinfection and testing procedure.
- I. After final disinfectant residuals test at or above 25 mg/L after a minimum 24-hour duration, flush disinfectant from system at a minimum velocity of 3.0 feet/second until residual is equal to that of incoming water or 1.0 mg/L.
- J. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain, analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

END OF SECTION

SECTION 22 10 23 - NATURAL GAS AND PROPANE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Natural Gas Piping System.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 22 05 00 for the required natural gas piping system electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 NATURAL GAS (0 to 125 PSI)

- A. Design Pressure: 125 psi. Maximum Design Temperature: 350°F
- B. Piping - 2" and Under:
 - 1. Pipe: Standard weight steel, threaded and coupled, ASTM A53.
 - 2. Joints: Screwed. (NOTE: For below ground, all sizes to have welded joints.)

3. Fittings: 150# steam - 300# CWP, black malleable iron, banded, ASTM A197, ANSI B16.3.
4. Unions: 250# - 500# CWP, black malleable iron, ANSI B16.39, ground joint with brass seat.

C. Shutoff Valves/Throttling Valves:

1. PL-1: 2" and under, 125# steam @ 450°F, 175# CWP @ 180°F, cast iron body, screwed, full port.
 - a. Manufacturers:
 - 1) Walworth #1700
 - 2) DeZurik #425, S-RS49

D. Gas Seismic Valves:

1. Provide a valve consisting of a swing check valve arrangement with an acceleration-sensitive triggering mechanism. The trip mechanism shall consist of a steel ball resting on a tapered cup-shaped support. The trip mechanism shall be factory set and sealed. A sight glass shall be provided so that the Open or Closed indicator can be seen, and the trip mechanism status of the valve can be easily determined. The valve assembly shall be certified by the California State Architect's Office, approved by the local authority, and meet the requirements of ANSI Z21.70 and ASCE 25-97. Refer to schedule for model number.

E. Check Valves:

1. CK-13: 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size.
 - a. Manufacturers:
 - 1) Mueller Steam Specialty Co. #71-AHB-6-H
 - 2) Stockham #WG-961 EPDM or #WG970 BUNA
 - 3) NIBCO W-920-W
 - 4) Crane

F. Strainers:

1. ST-4: Cast iron body, screwed ends, screwed cover, 250# steam @ 406°F, 300# CWP @ 150°F.
 - a. Manufacturers:
 - 1) Armstrong #A1SC
 - 2) Metraflex #SM
 - 3) Mueller Steam Specialty Co. #11
 - 4) Sarco #IT

2.2 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:
 - 1. Gases:
 - a. 1/4" - 2": 1/32" perforations
- B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.
- C. Use iron body strainers in ferrous piping.

2.3 DRAIN VALVES AND BLOWDOWN VALVES

- A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
- D. Connect to all equipment with flanges or unions.
- E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 TESTING PIPING

- A. Low Pressure - Up to 1 psi:
 - 1. Test piping with 20 psi air pressure. System must hold this pressure without adding air for two hours.
- B. High Pressure - Above 1 psi:
 - 1. Test piping with compressed air at twice the operating gas pressure, but at least 20 psi. System must hold this pressure without adding air for two hours.
- C. A non-combustible odorant, such as oil of wintergreen, may be added to help locate leaks.

3.3 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

3.4 INSTALLATION

- A. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
- B. Install piping to conserve building space, and not interfere with other work.
- C. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for access to valves and fittings.
- G. Provide access doors where valves are not exposed.
- H. Prepare pipe, fittings, supports, and accessories for finish painting.
- I. Install valves with stems upright or horizontal, not inverted.
- J. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
- K. Provide shutoff valves to isolate part of systems and vertical risers.
- L. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

- M. Reducers are generally not shown. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
- N. All vertical pipe drops to equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted.

3.5 BONDING AND GROUNDING

- A. Each above ground portion of a corrugated stainless steel tubing gas piping systems shall be bonded to the electrical service grounding electrode system. The bonding jumper shall connect to a metallic pipe or fitting between the point of delivery and the first downstream corrugated stainless steel tube fitting. The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent. Gas piping systems that contain one or more segments of corrugated stainless steel tubing shall be bonded in accordance with this section.
- B. Each above ground portion of a gas piping system, other than corrugated stainless steel tubing systems, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than corrugated stainless steel tubing, shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.
- C. Gas piping shall not be used as a grounding conductor or electrode.

3.6 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.
- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be long radius type, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.
- F. Use full and double lengths of pipe wherever possible.

- G. Cut all pipe to exact measurement and install without springing or forcing.
- H. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.
- I. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.

3.7 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage.
- B. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install gas pipes with bottom of pipe and eccentric reducers in a continuous line.
- C. Provide drip legs at low points and at the base of all risers in gas pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

3.8 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.
- C. Use of forged weld-on fittings is also limited as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Header or main must be 2-1/2" or over.
 - 3. Branch line is at least two pipe sizes under header or main size.
- D. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- E. All branch piping connections for natural gas shall take off on the top or on the side of the main.

3.9 JOINING OF PIPE

- A. Threaded Joints:
 - 1. Ream pipe ends and remove all burrs and chips.
 - 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
 - 3. Apply gas-rated Teflon tape or thread compound to male threads.

3.10 PAINTING EXPOSED PIPE

- A. Paint all outdoor exposed natural gas piping the color selected by Owner or Architect/Engineer.

3.11 SERVICE CONNECTIONS

- A. Provide new gas service complete with gas meter and regulators. Verify gas service pressure with the Utility Company.

END OF SECTION

SECTION 22 10 30 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cleanouts.
- B. Traps.
- C. Trap Seals and Primers.
- D. Floor Drains and Sinks
- E. Backflow Preventers.
- F. Unions.
- G. Balancing Valves.
- H. Water Hammer Arresters.
- I. Dielectric Fittings (Connections Between Dissimilar Metals).
- J. Relief Valves.

1.2 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.
- B. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Provide cleanouts as shown and specified on the drawings as well as required by code.
- B. Coordinate floor cleanout cover with surrounding floor finish. Provide either solid, recessed for tile or terrazzo or carpet marker as applicable.
- C. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.
- D. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

2.2 YARD CLEANOUTS

- A. Provide yard cleanouts as shown and specified on the drawings as well as required by code.
- B. Cleanout shall be same size as pipe up to 6" and 6" for larger pipes.

2.3 TRAPS

- A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be:
 - 1. Chromium plated cast brass when used with plumbing fixtures or when installed exposed in finished spaces.
 - 2. Insulated at accessible lavatories.
 - 3. Cast iron, deep-seal pattern where concealed above ceiling, below grade or in unfinished areas.
 - 4. Deep-seal pattern of the same material and/or coating where drainage lines are of special materials or coatings such as polypropylene, PVDF, CPVC, etc.
- B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.
- C. Each trap shall be completely filled with water at the end of construction but before building turnover to the Owner. All floor drains, floor sinks, trench drains, etc. shall be filled with water and a 1/2" minimum layer of mineral oil.

2.4 TRAP SEALS AND PRIMERS

- A. Provide trap seals as specified on the drawings.

2.5 FLOOR DRAINS

- A. Floor drains shall be in the form of a receptor with grate/strainer set flush with the surrounding floor.
- B. Provide floor drains and sinks as shown and specified on the drawings as well as required by code.

2.6 BACKFLOW PREVENTERS

- A. Provide backflow preventers as shown and specified on the drawings as well as required by code.

2.7 UNIONS

- A. Copper pipe - wrought copper fitting - ground joint.

2.8 BALANCING VALVE

- A. Rated for 125 psi working pressure and 250°F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.
- B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.
- C. Flow rate of 0.5 GPM or larger: Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Flow Design "Accusetter", Preso "B+", Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Griswold "Quickset", Gerand "Balvalve Venturi" or Nibco Globe Style balancing valve.
- D. Flow rate less than 0.5 GPM: Valves in copper piping shall be brass or bronze. Cv value shall be less than 1.0 when valve is completely open, and minimum balanceable flow rate shall not exceed 0.1 GPM with a meter reading of at least 2.5 feet. Acceptable manufacturers: Bell & Gossett "Circuit Setter RF", Flow Design, Preso, Armstrong, Griswold, Gerand, or Nibco balancing valve.
- E. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.9 WATER HAMMER ARRESTERS

- A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.
- B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between -100°F and 300°F and maximum 250 psig working pressure.

2.10 DIELECTRIC FITTINGS (CONNECTIONS BETWEEN DISSIMILAR METALS)

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.
- C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:
 - 1. Iron, steel, and stainless steel connected to each other.
 - 2. Brass, copper, and bronze connected to each other.

3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.
- E. Screwed Joints (acceptable up to 2" size):
1. Dielectric waterway rated for 300 psi CWP and 225°F.
 2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 47, Grinnell Series 407, Matco-Norca.
- F. Flanged Joints (any size):
1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
 2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
 3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
 4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
 5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
 6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.
- 2.11 RELIEF VALVES
- A. RV-4: (Domestic Hot Water) Pressure and Temperature relief, cast bronze body and internal parts, stainless steel spring, test lever, threaded inlet and outlet. Maximum setting of 150 psi and 210°F temperature. Capacities ASME certified and labeled. Acceptable Manufacturers: Cash Series FV, Watts #40, #120, #N240, #340.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Coordinate construction to receive drains at required invert elevations.
- B. Install all items per manufacturer's instructions.
- C. Water Hammer Arresters:
1. Install water hammer arresters in accessible locations. Provide access doors as required. Coordinate type with Architect/Engineer/Owner.

2. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and flush valves, squeeze handle spray faucets, and other similar type valves.
3. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in developed length from the cold and hot water mains.

D. Cleanouts:

1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet in pipe less than 6" size and 100 feet apart in 6" and larger pipes inside the building. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as required by code.
2. Extend cleanouts to the floor with long sweep elbows.
3. Install a full size, two-way cleanout within 5 feet of the foundation inside or outside of building.
4. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.
5. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12" above the finished floor.

E. Yard Cleanouts:

1. Install cleanouts on maximum 90 foot centers (including riser) for pipes 8" and smaller.
2. Extend cleanout to grade. Encase cleanout in 5" thick concrete pad extending 6" beyond cleanout, set low enough not to interfere with lawn mowers.

F. Trap Seals and Primers:

1. Install trap guard on drains not receiving continuous discharge and subject to drying out.

G. Floor Drains and Floor Sinks:

1. Coordinate sloping requirements with the architectural plans and specifications.
2. Top of floor drain and sinks grate/strainer shall not extend above the finished floor elevation.
3. Top of floor drain and sink grate/strainer shall not extend above the finished floor elevation. Grate/strainer shall be installed flush with surrounding finished floor. Should the Plumbing Contractor believe this presents a conflict with code, the issue should be evaluated before installation of the floor drain or sink begins. Proceeding with installing a floor drain or sink raised above the finished floor without prior approval will result in the Contractor being required to remove the drain or sink in question and reinstall it at the approved elevation.

H. Backflow Preventer:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.

2. Units shall be field tested and tagged in accordance with manufacturer's instructions and applicable codes by a certified tester before initial operation.
3. Install unit between 12" and 60" above finish floor.

I. Balancing Valves:

1. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as required, per manufacturer's installation instructions.

END OF SECTION

SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Domestic Water In-Line Circulators.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 22 05 00.
- B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.
- C. Pumps with motors operating above the RPM the pump curves are based on shall have impellers trimmed to deliver GPM and head scheduled.
- D. Submit certification that pumps, accessories, and components will withstand seismic forces defined in Section 22 05 50. Include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Construction shall permit complete servicing without breaking piping or motor connections.
- C. Pumps shall operate at 1750 rpm unless specified otherwise.
- D. Pump connections shall be flanged, whenever available.
- E. Domestic hot water pumps shall be suitable for 225°F water.

- F. Motors shall comply with Section 22 05 13.
- G. Submitted pump selections must have a diameter impeller that meets or exceeds the scheduled pump. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

2.2 DOMESTIC WATER IN-LINE CIRCULATORS

- A. Provide pumps as specified on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:

1. Install all products per manufacturer's recommendations.
2. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

- B. In-Line Pump:

1. Support in-line pumps individually so there is no strain on the piping. Support pump so no weight is carried on pump casings. Install with a minimum of five diameters of straight pipe on pump suction and discharge.
2. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
3. Pumps shall be factory aligned. If alignment is not satisfactory, as determined by the Architect/Engineer, manufacturer shall provide a factory trained representative to field align the shafts.
4. Alignment shall be inspected and approved by a factory trained representative. If alignment is not satisfactory, representative shall field align this shaft.

- C. Pump without VFD or ECM:

1. For pumps not powered by a VFD, trim impeller to meet maximum operating conditions. Coordinate final trimmed diameter with Testing, Adjusting, and Balancing Contractor.

END OF SECTION

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Heaters.

1.2 QUALITY ASSURANCE

- A. Products and installation of specified products shall conform to recommendations and requirements of the following organizations:
 - 1. American Gas Association (AGA).
 - 2. National Sanitation Foundation (NSF).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 - 5. National Electrical Manufacturers' Association (NEMA).
 - 6. Underwriters' Laboratories (UL).
- B. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1 when tested in accordance with DOE 10 CFR, ANSI Z21.10.1 and ANSI Z21.10.3.
- C. Conform to ASME Section VIII for construction of water heaters and heat exchangers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 22 05 00.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- D. For equipment connected to an electric power source, submit short circuit rating (SCCR) of integrated unit.
- E. Submit manufacturer's installation instructions including control and electrical power/controls wiring diagrams.
- F. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.
- G. Submit operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

- H. Submit certification that, water heaters, accessories, and components will withstand seismic forces defined in Section 22 05 50. Include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- I. Submit a current water analysis from the actual water source serving the project site for softening equipment verification before sending shop drawings to the Architect/Engineer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 REGULATORY REQUIREMENTS

- A. Water heaters shall conform to AGA, ANSI/NFPA 54, ANSI/NFPA 70, ANSI/UL 1453 as applicable.
- B. Conform to ANSI/ASME Section 8 Division 1 for fabrication of steel pressure vessels.
- C. Conform to ANSI/ASME Section 10 for manufacture of fiber-reinforced plastic pressure vessels.

PART 2 - PRODUCTS

2.1 WATER HEATERS

- A. All water heaters shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all items in accordance with manufacturer's instructions.

3.2 WATER HEATER INSTALLATION

- A. Install water heaters on concrete bases. Coordinate sizes and locations of concrete bases. Refer to Section 22 05 29.

- B. Install water heaters level and plumb, according to drawings, manufacturer's instructions, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend drain piping full size from relief valve and discharge by positive air gap onto closest floor drain. Discharge pipe material shall be same as domestic water piping.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All plumbing fixtures.

1.2 SUBMITTALS

- A. Submit product data under provisions of Section 22 05 00. Submittals shall include fixture carriers for record purposes only. Architect/Engineer does not review or approve carriers except for manufacturer.
- B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. For fixtures and trim requiring electrical connections, submit product data indicating general assembly, components, electrical power/controls wiring diagrams, and service connections.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wall Hung Fixture Carriers:
 - 1. Material: All Metal, ASME/ANSI A112.6.1M.
 - 2. Manufacturers:
 - a. Zurn
 - b. Smith
 - c. Wade
 - d. Josam
 - e. Watts
 - f. Mifab.
 - 3. Water closet carrier shall be rated to support 500 lbs. unless noted otherwise on the drawings.
- B. All fixtures shall be as scheduled on the drawings.
- C. All china shall be from the same manufacturer where possible.
- D. All lavatory and sink trim shall be from the same manufacturer where possible.
- E. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.
3. Provide fixtures with chrome plated rigid or flexible supplies, loose key stops, reducers, and escutcheons.
4. Install components level and plumb.
5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicon caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.
6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.
7. Refer to Plumbing Material List for fixture mounting heights.
8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

B. Wall-Mounted Fixture Requirements:

1. All wall-mounted fixtures shall have compatible carriers designed for their intended service and suitable for the space available and configuration of fixtures. All carriers shall extend to the floor and be anchored to the slab.

C. Floor-Mounted Fixture Requirements:

1. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration to the floor below.

D. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:

1. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.
2. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.
3. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor the piping to the wall.
4. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.

3.2 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

- A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION

SECTION 23 05 00 - BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 23 Sections. Also refer to Division 01 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Air Conditioning and Ventilating Contractor.
 - c. Temperature Control Contractor.
 - d. Testing, Adjusting, and Balancing Contractor.
2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.
6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Makeup Air Units.
 - b. Package Air Handling Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
4. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.3 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-

dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Robinson, Illinois Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of Illinois Eastern Community College.
3. Conform to all State Codes.
4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
5. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. Make application for and pay for service connections, such as gas.
4. Make application for and pay for all meters and metering systems required by the utility company.

F. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.4 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

Referenced Specification	Submittal Item
23 05 13	Motors
23 05 50	Seismic Restraint Systems
23 31 00	Ductwork Layout Drawings
23 37 00	Grilles, Registers, and Diffusers
23 74 16.12	Packaged Rooftop Air Conditioning Units - 25T and Below
23 74 16.15	Packaged Rooftop Air Conditioning Units for Dedicated Outside Air
23 82 00	Terminal Heat Transfer Equipment

- B. General Submittal Procedures: In addition to the provisions of Division 01, the following are required:

1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)

- e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
- a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.

- 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
- d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions, or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
 15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.

- a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.
- C. Electronic Submittal Procedures:
1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
 3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
 4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 23 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 23 XX XX.description.YYYYMMDD
 5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.5 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 01.
- B. Format:
1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
 2. Submit in Excel format.
 3. Support values given with substantiating data.
- C. Preparation:
1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
 2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.

- D. Update Schedule of Values when:
 - 1. Indicated by Architect/Engineer.
 - 2. Change of subcontractor or supplier occurs.
 - 3. Change of product or equipment occurs.

1.6 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.7 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.8 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.9 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.10 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the scheduled manufacturer is the basis for job design and establishes the quality required.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in

accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
 - 1. Placing fill over underground and underslab utilities.
 - 2. Covering exterior walls, interior partitions and chases.
 - 3. Installing hard or suspended ceilings and soffits.

- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

- C. Above-Ceiling Final Observation
 - 1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. Pipe insulation is installed and fully sealed.
 - b. Pipe and duct wall penetrations are sealed.
 - c. Pipe identification and valve tags are installed.
 - d. Main, branch and flexible ducts are installed.
 - e. Diffusers, registers and grilles are installed and connected to ductwork.

 - 2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

 - 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.3 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 01.

- B. Final Jobsite Observation:
 - 1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.

 - 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.

3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including marked-up or reproducible drawings and specifications.
3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.
4. Start-up reports on all equipment requiring a factory installation inspection or start-up.
5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; receipt by Architect/Engineer required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div23.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.
6. Copies of warranties.
7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- C. The instructions shall include:
 1. Explanation of all system flow diagrams.

2. Explanation of all air handling systems.
 3. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
 4. Maintenance of equipment.
 5. Start-up procedures for all major equipment.
 6. Explanation of seasonal system changes.
 7. Description of emergency system operation.
- D. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.
- E. Minimum hours of instruction for each item shall be:
1. Air Handling System(s) - 4 hours.
 2. Exhaust System(s) - 4 hours.
- F. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.
- G. Operating Instructions:
1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.
 2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 SYSTEM STARTING AND ADJUSTING

- A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.

- D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 01 requirements.
- B. Maintain at the job site a separate and complete set of mechanical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- E. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.
- D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.9 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.10 MAINTAINING CLEAN DUCTWORK THROUGHOUT CONSTRUCTION

- A. Throughout the duration of construction, all ductwork shall be capped or sealed with sheet metal caps, polyethylene film, or other airtight protective to keep dust, dirt, and construction debris out of ducts. Similar means shall be used to seal air-side connections of HVAC equipment to include, but not limited to, air handling units, fans, terminal air boxes, fan coil units, cabinet heaters, blower coils, and the like.
- B. When air terminal devices are installed, contractors shall seal all supply, return, and exhaust grilles with polyethylene film or other airtight protective to keep dust, dirt, and construction debris out of ducts.
- C. Should HVAC equipment be started during construction, Contractor shall remove airtight protectives and shall install one-inch thick MERV 8 filter media over all return and exhaust grilles to prevent dust, dirt, and construction debris from entering ductwork. Filter media shall cover the entire grille face and shall be secured such that air cannot bypass filter media.
- D. Should filter media become laden with dust and dirt, Contractor shall replace filter media with new media to prevent damage to air distribution system and equipment.
- E. The following steps shall be taken during testing, adjusting, and balancing of each air system:
 - 1. All construction activities in all spaces served by the air system shall stop.
 - 2. All airtight protectives and temporary filter media shall be removed from all portions of the air system.
 - 3. Testing, adjusting, and balancing work shall not commence until all construction activity is stopped and all airtight protectives and temporary filter media is removed.

4. Once testing, adjusting, and balancing work is complete for the air system, airtight protectives or temporary filter media shall be installed over all ductwork openings and air terminals on the air system prior to resuming construction activities in any spaces served by the air system.
- F. The Owner shall agree the building is sufficiently clean prior to the removal of any filtration media and airtight protectives from air terminal devices.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All air handling units operating and balanced.
3. All fans shall be operating and balanced.
5. All miscellaneous mechanical systems (unit heaters, fan coil units, cabinet heaters, etc.) operating.
6. All temperature control systems operating, programmed and calibrated.
7. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

SECTION 23 05 13 - MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Phase and Three Phase Electric Motors.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00. Include nominal efficiency and power factor for all premium efficiency motors. Efficiencies must meet or exceed the nominal energy efficiency levels presented below.
- B. Submit shop drawings for all three phase motors.
- C. Submit motor data with equipment when motor is installed by the manufacturer at the factory.
- D. Submit shaft grounding rings or brushes for all motors as required.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

PART 2 - PRODUCTS

2.1 MOTORS - GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Refer to the drawings for required electrical characteristics. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115

208	200
240	230
277	265
480	460

- B. Design motors for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.
- D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- E. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.
- F. Each contractor shall set all motors furnished by him.
- G. All motors shall have a minimum service factor of 1.15.
- H. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.
- I. Aluminum end housings are not permitted on motors 15 HP or larger.
- J. Motor Driven Equipment:
 - 1. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.
 - 2. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.
- K. Motors for fans and pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed.

2.2 ELECTRICALLY COMMUTATED MOTORS (ECM)

- A. Motor shall be variable speed, constant torque, brushless DC motor for direct-drive applications. Electronics shall be encapsulated for moisture protection and shall integral surge protection. Motor shall be pre-wired for specific voltage and phase.

- B. Motor frame shall be NEMA 48; UL recognized components shall be provided for the motor construction.
- C. All EC motors shall be a minimum of 85% efficient at all speeds.
- D. Motors shall be permanently lubricated; utilize ball bearings to match with the connected driven equipment.
- E. Provide motor with on-board motor control module. Motor speed shall be limited to provide electronic over current protection. Starter shall provide soft start to reduce inrush current and shall be controllable from 20% to 100% of full rated speed.
- F. Operational mode shall be as scheduled and shall be one of the following:
 - 1. Constant Flow
 - 2. Constant Temperature
 - 3. Constant Pressure

2.3 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

- A. All motors, unless exempted by EAct legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

HP	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10.0	91.7	91.7	89.5	91.0	91.7	90.2

- B. Motor nameplate shall be noted with the above ratings.

2.4 MOTORS ON VARIABLE FREQUENCY DRIVES

- A. All motors driven by VFDs shall be premium efficiency type.
- B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors shall not be equipped with auxiliary blowers.

- C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, "Performance Standards Applying to All Machines," Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors.
- D. All three-phase motors driven by VFDs shall be provided with shaft grounding rings or grounding brushes as a means to protect bearings from adverse shaft currents.
 - 1. Providing grounding rings internal to the motor housing is an acceptable solution, provided the motor is affixed with a label clearly indicating the presence of a grounding assembly. The grounding ring shall be listed for 40,000 hours of motor service and shall be accessible via the drive endplate.
 - 2. Motor shafts 2" and larger require shaft grounding on the drive end and the non-drive end. This Contractor shall ensure (via field observation and measurement) that the shaft is effectively grounded upon startup.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.
- B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.

END OF SECTION

SECTION 23 05 50 - SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Seismic Requirements.

1.2 QUALITY ASSURANCE

A. General:

1. The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint and support system and perform seismic calculations in accordance with these specifications, state, and local codes.
2. Items used for seismic restraint of equipment and systems shall be specifically manufactured for seismic restraint.
3. These requirements are beyond those listed in Section 23 05 29 of these specifications. Where a conflict arises between the seismic requirements of this section and any other section, the Architect/Engineer shall be immediately notified for direction to proceed.

B. Manufacturer:

1. System Supports/Restraints: Company specializing in the manufacture of products specified in this Section.
2. Equipment: Each company providing equipment that must meet seismic requirements shall provide certification included in project submittals the equipment supplied for the project meets or exceeds the seismic requirements of the project.

- C. Testing Agency: An independent testing agency, acceptable to Authorities Having Jurisdiction, with experience and capability to conduct the testing indicated.

- D. Installer: Company specializing in performing the work of this Section.

1.3 SUBMITTALS

- A. Submit under provisions of Section 23 05 00.

B. Shop Drawings:

1. Calculations, restraint selections, and installation details shall be designed and sealed by a Professional Engineer licensed in the state where the project is located experienced in seismic restraint design and installation.
2. Coordination Drawings: Plans and sections drawn to scale, coordinating seismic bracing of mechanical components with other systems and equipment in the vicinity, including other seismic restraints.

3. Manufacturer's Certifications: Professional Engineer licensed in the state where the project is located shall review and approve manufacturer's certifications of compliance.
4. System Supports/Restraints - Submit for each condition requiring seismic bracing:
 - a. Calculations for each seismic brace and detail utilized on the project.
 - b. Plan drawings showing locations and types of seismic braces on contractor fabrication/installation drawings.
 - c. Cross-reference between details and plan drawings to indicate exactly which brace is being installed at each location. Details provided are to clearly indicate attachments to structure, correctly representing the fastening requirements of bracing.
 - d. Clear indication of brace design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.
5. Equipment - Submit for each piece of equipment supplied:
 - a. Certification that the equipment supplied for the project meets or exceeds the seismic requirements specified.
 - b. Specific details of seismic design features of equipment and maximum seismic loads imparted to the structural support.
 - c. Engineering calculations and details for equipment anchorage and support structure.

C. A seismic restraint designer shall be provided whether or not exceptions listed in the applicable building code are met. If seismic restraints are not provided for a system that requires seismic bracing, the seismic designer shall submit a signed and sealed letter to the Architect/Engineer and Authorities Having Jurisdiction stating the exceptions, along with code reference, utilized for each item. Seismic designer shall review system installation for general conformance to the exception requirements stated in the code and document, in writing, the system has been installed in accordance to the exception.

1.4 TESTING AND INSPECTION

- A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the Building Code.
- B. The Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.
- C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.

- D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

1.6 DESIGN REQUIREMENTS

- A. This project is subject to the seismic bracing requirements of the International Building Code, 2021 edition.
- B. The following criteria are applicable to this project:
 - 1. Risk Category: II
 - 2. Seismic Design Category: D
 - 3. Component Amplification Factors (ap) and Component Response Modification Factors (Rp) shall be taken from Table 1621.3r in CBC 2016 for the individual equipment or system being restrained.
 - 4. Component Importance Factors (Ip) shall be taken from Section 1621.1.6 in CBC 2016 for the individual equipment or system being restrained.
 - 5. The total height of the structure and the height of the system to be restrained within the structure shall be determined in coordination with architectural plans and the General Contractor.
- C. Forces shall be calculated with the above requirements and Equation of CBC 2016 unless exempted by 13.1.4. Equipment shall meet International Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

1.7 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

1.8 WARRANTY

- A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

PART 2 - PRODUCTS

2.1 SUPPLIERS

A. Following is a partial list of manufacturer/supplier contact information for seismic restraints:

1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.
2. Unistrut Corporation <http://www.unistrut.us/>
3. Kinetics Noise Control (877) 457-2695, www.kineticsnoise.com.
4. Mason Industries, Inc. www.mason-ind.com.
5. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.
6. Tolco (909) 737-5599, www.tolco.com
7. ISAT 877.523.6060, www.isatsb.com
8. Vibro-Acoustics (416) 291-7371 , <https://virs.vibro-acoustics.com/>

2.2 SEISMIC DESIGN CRITERIA

A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.

B. Definitions

1. Stay in Place:
 - a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.

2.3 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

A. General:

1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.
2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.
3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.
5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.
6. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

C. Housekeeping Pads:

1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

2.4 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

- A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.
- B. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:
 1. Air Handling Units

2.5 MATERIALS

- A. Use the following materials for restraints:
 1. Indoor Dry Locations: Steel, zinc plated.
 2. Outdoors and Damp Locations: Galvanized steel.
 3. Corrosive Locations: Stainless steel.

2.6 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.7 SEISMIC BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
 - 1. Materials for Channel: ASTM A 1011, GR 33.
 - 2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.
 - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
 - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
 - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
 - 2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.
- B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.
- C. All rigid floor mounted equipment shall have a resilient media between the equipment mounting hole and the anchor bolt in concrete.
- D. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- E. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.

- F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
- G. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
- H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.
- I. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.
- K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.
- L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.
- M. Do not install cables over sharp corners.
- N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.
- O. Provide reinforced clevis bolts when required.
- P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.
- Q. Post-Installed anchors shall be provided to meet seismic requirements.
- R. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
- S. Independently brace duct mounted equipment (terminal units, in-line fans, etc.) and the associated suspended ductwork.
- T. Do not brace a system to two different structures such as a wall and a ceiling.
- U. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- V. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.

- W. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.
- X. Coordinate seismic bracing of architecturally exposed ductwork with the Architect/Engineer.

3.2 SEISMIC RESTRAINT EXCLUSIONS

- A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

END OF SECTION

SECTION 23 05 53 - HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 3M
- B. Bunting
- C. Calpico
- D. Craftmark
- E. Emedco
- F. Kolbi Industries
- G. Seton
- H. W.H. Brady
- I. Marking Services.

2.2 MATERIALS

- A. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- B. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjusting, and balancing of air systems.
- B. Testing, adjusting, and balancing of heating systems.
- C. Testing, adjusting, and balancing of cooling systems.
- D. Testing, adjusting, and balancing of plumbing systems.
- E. Testing, adjusting, and balancing of energy recovery systems.

1.2 QUALITY ASSURANCE

- A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.
- B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.3 REFERENCES

- A. AABC - National Standards for Total System Balance, Seventh Edition.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. AMCA - Publication 203-90; Field Performance Measurement of Fan Systems.
- D. ASHRAE - 2019 HVAC Applications Handbook; Chapter 39, Testing, Adjusting and Balancing.
- E. ASHRAE/ANSI - Standard 111-2008; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.
- F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Ninth Edition, 2019.
- G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing (latest edition).
- H. TABB - International Standards for Environmental Systems Balance.

1.4 SUBMITTALS

- A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.
- B. Electronic Copies:
 - 1. Submit a certified copy of test reports to the Architect/Engineer for approval. Electronic copies shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Copies that are not legible will be returned to the Contractor for resubmittal. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
 - 2. Electronic file size shall be limited to a maximum of 10MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
 - 3. All text shall be searchable.
 - 4. Bookmarks shall be used. All bookmark titles shall be an active link to the index page and index tabs.

1.5 REPORT FORMS

- A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.
- B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.
- C. Refer to PART 4 for required reports.

1.6 WARRANTY/GUARANTEE

- A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.
- B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.7 SCHEDULING

- A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.
- B. The Balancing Contractor shall incorporate all pertinent documented construction changes (e.g. submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.
- C. Recorded data shall represent actual measured or observed conditions.
- D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.
- E. Permanently mark setting of dampers and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.
- G. Installations with systems consisting of multiple components shall be balanced with all system components operating.

3.2 EXAMINATION

- A. Before beginning work, verify that systems are complete and operable. Ensure the following:
 - 1. General Equipment Requirements:
 - a. Equipment is safe to operate and in normal condition.
 - b. Equipment with moving parts is properly lubricated.
 - c. Temperature control systems are complete and operable.
 - d. Proper thermal overload protection is in place for electrical equipment.
 - e. Direction of rotation of all fans and pumps is correct.
 - f. Access doors are closed and end caps are in place.
 - 2. Duct System Requirements:
 - a. All filters are clean and in place. If required, install temporary media.

- b. Duct systems are clean and free of debris.
 - c. Fire/smoke and manual volume dampers are in place, functional and open.
 - d. Air outlets are installed and connected.
 - e. Duct system leakage has been minimized.
 - B. Report any defects or deficiencies to Architect/Engineer.
 - C. Promptly report items that are abnormal or prevent proper balancing.
 - D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
 - E. Beginning of work means acceptance of existing conditions.
- 3.3 PREPARATION
- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.
 - B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.
- 3.4 INSTALLATION TOLERANCES
- A. $\pm 10\%$ of scheduled values:
 - 1. Adjust air inlets and outlets to $\pm 10\%$ of scheduled values.
 - B. $+ 5\%$ of scheduled values
 - 1. Adjust outdoor air intakes to within $+ 5\%$ of scheduled values.
 - 2. Adjust exhaust air through energy recovery equipment to within $+5\%$ of scheduled values.
 - C. Adjust supply, return, and exhaust air-handling systems to $+10\%$ / -5% of scheduled values.
- 3.5 ADJUSTING
- A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.
 - B. Once balancing of systems is complete, at least one damper or valve must be 100% open.
 - C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.
 - D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.

- E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

3.6 SUBMISSION OF REPORTS

- A. Fill in test results on appropriate forms.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 GENERAL REQUIREMENTS

- A. Title Page:

1. Project name.
2. Project location.
3. Project Architect.
4. Project Engineer (IMEG Corp.).
5. Project General Contractor.
6. TAB Company name, address, phone number.
7. TAB Supervisor's name and certification number.
8. TAB Supervisor's signature and date.
9. Report date.

- B. Report Index

- C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

- D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

4.2 AIR SYSTEMS

- A. Duct Leakage Test:

1. Air system and fan.
2. Leakage class.
3. Test pressure.

4. Construction pressure.
5. Flow rate (cfm): specified and actual.
6. Leakage (refer to Section 23 31 00 in the specifications): specified and actual.
7. Pass or Fail.
8. Test performed by.
9. Test witnessed by.

B. Air Moving Equipment:

1. General Requirements:
 - a. Drawing symbol.
 - b. Location.
 - c. Manufacturer, model, arrangement, class, discharge.
 - d. Fan RPM.
 - e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
 - f. Final frequency of motor at maximum flow rate (on fans driven by VFD).
2. Flow Rate:
 - a. Supply flow rate (cfm): specified and actual.
 - b. Return flow rate (cfm): specified and actual.
 - c. Outside flow rate (cfm): specified and actual.
 - d. Exhaust flow rate (cfm): specified and actual.
3. Pressure Drop and Pressure:
 - a. Filter pressure drop: specified and actual.
 - b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
 - c. Inlet pressure.
 - d. Discharge pressure.

C. Fan Data:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Total static pressure: specified and actual. (Indicate measurement locations).
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

D. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.

3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

E. Air Terminal (Inlet or Outlet):

1. Drawing symbol.
2. Room number/location.
3. Terminal type and size.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Percent of design flow rate.

4.3 HEATING SYSTEMS

A. Heating Coils:

1. General Requirements:
 - a. Drawing symbol.
 - b. Service.
 - c. Location.
 - d. Manufacturer and model.
 - e. Size.
2. Flow Rate:
 - a. Flow rate (cfm): specified and actual.
3. Temperature:
 - a. Entering air temperature: specified and actual.
 - b. Leaving air temperature: specified and actual.
4. Pressure Drop and Pressure:
 - a. Air pressure drop: specified and actual.
5. Energy:
 - a. Air Btuh (cfm x temp rise x 1.09).

B. Terminal Heat Transfer Units:

1. General Requirement:
 - a. Drawing symbol.
 - b. Location.
 - c. Manufacturer and model.
 - d. Include air data only for forced air units.

2. Flow Rate:
 - a. Flow rate (cfm): specified and actual.
3. Temperature:
 - a. Entering air temperature: specified and actual.
 - b. Leaving air temperature: specified and actual.
4. Energy:
 - a. Air Btuh (cfm x temperature rise x 1.09).

4.4 COOLING SYSTEMS

A. Cooling Coils:

1. General Requirements:
 - a. Drawing symbol.
 - b. Service.
 - c. Location.
 - d. Size.
 - e. Manufacturer and model.
2. Temperature:
 - a. Entering air DB temperature: specified and actual.
 - b. Entering air WB temperature: specified and actual.
 - c. Leaving air DB temperature: specified and actual.
 - d. Leaving air WB temperature: specified and actual.
3. Flow Rate:
 - a. Flow rate (cfm): specified and actual.
4. Pressure Drop and Pressure:
 - a. Air pressure drop: specified and actual.
5. Energy:
 - a. Air Btuh (cfm x enthalpy change x 4.5).

4.5 PLUMBING SYSTEMS

A. Pump Data:

1. Drawing symbol.

2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shutoff.
7. Suction Pressure: operating and shutoff.
8. Discharge Pressure: operating and shutoff.

B. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, model, frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps for each phase.

C. Balancing Valve:

1. Drawing symbol.
2. Service.
3. Location.
4. Size.
5. Manufacturer and model.
6. Flow rate (gpm): specified and actual.
7. Pressure drop: specified and actual.

4.6 ENERGY RECOVERY SYSTEMS

A. Air Systems - Air energy recovery devices shall be tested at ambient temperatures of less than 40°F or greater than 85°F.

1. Energy Recovery Wheel:

a. General Requirements:

- 1) Drawing Symbol.
- 2) Location.
- 3) Wheel RPM.

b. Primary Air:

- 1) Primary Entering Air Temperature.
- 2) Primary Leaving Air Temperature.
- 3) Primary Air Pressure Drop.
- 4) Primary Air Flow Rate (cfm).

c. Secondary Air:

- 1) Secondary Entering Air Temperature.
- 2) Secondary Leaving Air Temperature.

- 3) Secondary Air Pressure Drop.
- 4) Secondary Air Flow Rate (cfm).

END OF SECTION

SECTION 23 07 13 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Ductwork Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.
- B. Materials:
 - 1. Listed and labeled for flame spread/smoke developed rating of no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
 - 2. Fungal Resistance: No growth when tested in accordance with ASTM G21 (antifungal test).
 - 3. Rated velocity on coated air side for air erosion in accordance with UL 181 at 5,000 fpm minimum.
 - 4. UL listed in Category HNKT.
- C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 / 0.26 (Out-Of-Package/Installed-Compressed 25%) maximum 'K' value at 75°F; foil scrim Kraft facing, 1.0 lb./cu. ft. density. Submit both "Out of Package" and "Installed-Compressed 25%" K and R-values.
- B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75°F; foil scrim Kraft facing, 3 lb./cu. ft. density.
- C. Type C: Flexible Fiberglass Liner; ANSI/ASTM C1071; 0.28 maximum 'K' value at 75°F; 1.5 lb/cu ft minimum density; coated air side for 5000 fpm air velocity.

2.2 JACKETS

- A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.3 JACKET COVERINGS

- A. Aluminum Jackets: ASTM B209; 0.016" thick; smooth or embossed stucco finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.
- B. Laminated flexible aluminum, self-adhering, protective jacketing, vapor barrier and weather proofing membrane with having high-performance adhesive capable of installation with no additional mechanical attachment. Owner/Architect shall select from manufacturer's standard finishes.
 - 1. Acceptable Manufacturers:
 - a. VentureClad 1579CW
 - b. Polyguard Alumaguard

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.
- B. Install materials after ductwork has been tested.
- C. Clean surfaces for adhesives.
- D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
- E. Exterior Duct Wrap - Flexible, Type A:
 - 1. Apply with edges tightly butted.
 - 2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.
 - 3. Seal joints with adhesive backed tape.
 - 4. Apply so insulation conforms uniformly and firmly to duct.
 - 5. Seal all penetrations of the vapor barrier by strap hangers or slip cable hangers with adhesive backed tape.
 - 6. Provide high-density insulation inserts on rectangular ducts at trapeze duct hangers to prevent crushing of insulation. Provide high-density insulation inserts with clamp-on round ducts requiring two (2) rods or straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.

7. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
8. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.
9. Staples may be used, but must be covered with tape.
10. Vapor barrier must be continuous.
11. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.

F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):

1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.
3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.
4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.

G. Semi Rigid Fiberglass Board Wrap - Type B (Outdoor Use):

1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
2. Space pins as required to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.
3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of the same facing tape with adhesive.
4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.
5. Install vapor barrier jacket. Cover with aluminum or laminated aluminum jacket covering with seams on the bottom of horizontal ductwork.
6. Seal all butt joints with metal draw bands screwed to jacket and filled with sealant. Seal all joints watertight.
7. Provide positive slope on top of all horizontal surfaces to prevent ponding of water.

H. Interior Insulation - Flexible Duct Liner, Type C:

1. Observation of Duct Lining:
 - a. After installation of ductwork, Architect/Engineer may select random observation points in each system.
 - 1) At each observation point, cut and remove an 18" x 18" section of ductwork and liner for verification of installation.
 - 2) Random observation points based on one opening per 75 lineal ft. of total duct run.

- b. When any of the observation points shows non-compliance, additional points will be designated by the Architect/Engineer, and observation repeated.
 - c. If 20% of points observed do not comply, remove and replace all lined ducts and repeat tests. Where replacement is not required, correct all non-compliances.
 - d. At end of observation, repair all duct lining and observation holes by installing standard, insulated, hinged access doors per Section 23 33 00.
 - e. Paint or finish to match adjacent duct surfaces.
2. Impale on spindle anchors welded or mechanically fastened to the duct. Adhesive or glue fastened anchors are not acceptable. Maximum anchor spacing per SMACNA Duct Construction Standards or manufacturer's recommendations, whichever is more restrictive. Locate pins less than 3" from corners and at intervals not over 6" around the perimeter at leading and trailing edges. Locate pins within 3" of transverse joints and at intervals not over 16" long the length of the duct. Pins must be long enough to prevent compressing the insulation.
 3. In addition to anchors, secure liner with UL listed adhesive covering over 90% of the duct surface.
 4. Install per the latest edition of the SMACNA Manual.
 5. Leading edges shall be covered as follows:
 - a. For duct velocities below 3000 fpm, coat leading edges with adhesive. Neatly butt liner without gaps at transverse joints. Cut liner flush with end of the duct section for tight joints with no exposed duct. If adhesive is shop installed, field apply additional adhesive to the end of each duct section for complete adhesion of the liner. Protect edges from dirt and debris.
 - b. For duct velocities above 3000 fpm, cover leading edges with metal nosing. Use nosing on upstream edges of each section of duct. If the duct can be installed in either direction, provide nosing on each end or clearly mark the duct to allow visual verification after installation. Verify duct velocities based on the scheduled air flow rates and determine where metal nosing is required.
 - c. Install metal nosing in the following locations (regardless of velocity):
 - 1) The first three fittings downstream of all fans.
 - 2) At all duct liner interruptions. This includes fire dampers, access doors, branch connections, and all other locations where the edge of the liner is exposed.
 - 3) Trailing edges of transverse joints do not require metal nosings.
 6. Overlap liner at longitudinal joints. Make longitudinal joints at corners of the duct unless the duct size does not allow this. Coat longitudinal joints with adhesive at velocities over 2500 fpm.
 7. Seal all damaged duct liner with adhesive and glass cloth. Do not damage duct liner surface coatings.
 8. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation thickness.
- I. Continue insulation with vapor barrier through penetrations unless code prohibits.

- J. Provide 2" wide, 24" high, 26 gauge, galvanized sheet metal corner protection angles for all externally insulated ductwork extending to a floor or curb.

3.2 SCHEDULE

- A. Refer to Section 23 31 00 for scheduling of insulation.

END OF SECTION

SECTION 23 31 00 - DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Galvanized Ductwork
- B. Ductwork Reinforcement
- C. Ductwork Sealants
- D. Rectangular Ductwork
- E. Round and Flat Oval Ductwork
- F. Exposed Ductwork (Rectangular, Round, or Oval)
- G. Flexible Duct
- H. Leakage Testing
- I. Ductwork Penetrations

1.2 DEFINITIONS

- A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.
- B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.
- C. Exterior Duct: Ductwork located outside the conditioned envelope including exposed ductwork above the roof, outside exterior walls, in attics above insulated ceilings, inside parking garages, and crawl spaces.
- D. Interior Duct: Ductwork located within the conditioned envelope including return air plenums and indirectly conditioned spaces.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS AND SUPPORTS

- A. Rectangular Duct - Single Wall:
 - 1. General Requirements:

- a. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.
 - b. Transitions shall not exceed the angles in Figure 4-7.
2. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:
- a. All ducts shall be cross-broken or beaded.
 - b. Snap lock seams are not permitted.
 - c. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:
 - 1) Type 1:
 - a) Description: Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.
 - b) Usage: Limited to 3,000 fpm and vane lengths 36" and under.
 - 2) Type 2:
 - a) Description: Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.
 - b) Usage: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.
 - 3) Type 3 (acoustical - where acoustical lagging is located or as noted on drawings):
 - a) Description: Same as Type 2, except filled with fiberglass and with slotted or perforated inner curve. Minimum insertion loss of 9 dB at 250 Hz and 6 dB at 1 KHz.
 - b) Usage: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.
 - 4) Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.
 - 5) Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.
 - 6) Omitting every other vane is prohibited.

- d. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. Mitered elbows (with or without turning vanes) may not be substituted for radius elbows. Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.
- e. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.
- f. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.
- g. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.
- h. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.
- i. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.
- j. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6" in length.
- k. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
 - 1) Apply sealant to all inside corners. Holes at corners are not acceptable.
 - 2) Manufacturers:
 - a) Ductmate Industries - 25/35/45
 - b) Nexus
 - c) Mez
 - d) WDCI
 - e) Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

1. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
 - 1) Apply sealant to all inside corners. Holes at corners are not acceptable.
 - 2) Flanges shall be 24-gauge minimum (not 26 gauge).
 - 3) Manufacturers:
 - a) Lockformer TDC
 - b) TDF
 - c) United McGill
 - d) Sheet Metal Connectors
 - e) Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

B. Round and Flat Oval Spiral Seam Ductwork - Single Wall:

1. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.
2. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.
3. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
4. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.
5. Ductwork shall be suitable for velocities up to 5,000 fpm.
6. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.
7. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
8. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.
9. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.
10. Transverse Joint Connections:
 - a. Crimped joints are not permitted.

- b. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.
- c. Ducts and fittings larger than 36" shall have flanged connections.
- d. Secure all joints with at least 3 sheet metal screws before sealing.
- e. Manufacturers, Slide-on Flanges:
 - 1) Ductmate Industries - SpiralMate
 - 2) Accuflange
 - 3) Sheet Metal Connectors are acceptable.
- f. Manufacturers, Self-Sealing Duct Systems:
 - 1) Lindab
 - 2) Ward "Keating Coupling"

C. Hangers and Supports General Requirements:

- 1. Hanger and support materials shall be as defined within Materials and Application Specific section below.
- 2. Strap Hangers: Strap hanger shall be a minimum of 1 inch, 18 gauge attached to the bottom of ducts.
- 3. Cable Hangers:
 - a. Aircraft cable and slip cable hangers are acceptable for ducts up to 18" diameter. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting rectangular ductwork.
 - b. Manufacturers; Supports:
 - 1) Gripple
 - 2) Ductmate
 - 3) Duro Dyne
 - 4) Architect/Engineer approved
- 4. Integral Corner Connector Hanger: Integral hanger and corner assembly for use with TDC/TDF style duct flanges. Die stamped offset hanger connects to the flanged corner assembly. For use with aircraft cable or 1/4" or 3/8" diameter threaded rods. Tested to hold up to 1,400 lbs. Install per manufacturer's ratings and instructions.
 - a. Manufacturers; Supports:
 - 1) EZ Hanger

2.2 MATERIAL AND APPLICATION SPECIFIC

A. Galvanized Steel:

1. General Requirements:
 - a. Duct and reinforcement materials shall conform to ASTM A653 and A924.
 - b. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.
 - c. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.
 - d. Ductwork reinforcement shall be of galvanized steel.
2. Duct Hangers and Support Material:
 - a. Ductwork hangers and supports shall be of galvanized or painted steel.
 - b. All fasteners shall be galvanized or cadmium plated.

B. Duct Hangers and Support Material:

1. Ductwork hangers and supports shall be of galvanized or painted steel.
2. All fasteners shall be galvanized or cadmium plated.

2.3 DUCTWORK REINFORCEMENT

- A. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.
1. Ducts must be over 18" wide.
 2. Duct dimensions must be increased 2" in one dimension (h or w) for each row of tie rods installed.
 3. Tie rods must not exceed 1/2" diameter.
 4. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

2.4 DUCTWORK SEALANTS

- A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.
- B. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20°F to +250°F.

C. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20°F to +250°F.

1. Manufacturers, Pressure-Sensitive Tape:

- a. Venture Tape 1581A
- b. Compac #340
- c. Scotch Foil Tape 3326
- d. Polyken 339

2.5 FLEXIBLE DUCT

A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.

B. Flame Spread/Smoke Developed: Not over 25/50.

C. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.

D. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.

E. Acoustic:

1. Flexible duct shall be acoustic rated in accordance with ASTM E477 and ADC Test Code FD 72-RI by ETL. Insertion loss values noted below are for flow velocities less than 2,500 fpm. Submittals shall include insertion losses ratings per sizes and lengths listed below regardless of sizes shown on the drawings.

2. Flexible have corrosion-resistant wire helix, bonded to a nylon fabric core inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh. Usage: All areas unless noted otherwise.

3. Inner liner shall be airtight and suitable for 6" WC static pressure through 16" diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A. "R" value shall not be less than 4.0 ft²*°F*hr/Btuh.

Temperature range of at least 0-180°F. Maximum velocity of 4,000 fpm. "R" value shall not be less than 4.0 ft²*°F*hr/Btuh. Ducts in unconditioned spaces and ventilated attics: "R" value shall not be less than 6.0 ft²*°F*hr/Btuh.

4. Minimum Acoustic Insertion Losses per octave band:

a. Straight Duct:

		63hz	125hz	250hz	500hz	1000hz	2000hz	4000hz
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		63hz	125hz	250hz	500hz	1000hz	2000hz	4000hz
6" ø	6 ft	4.0	13	15	15	16	17	16
6" ø	3 ft	2.3	4.9	5.3	5.3	5.5	5.8	5.4
8" ø	6 ft	5.7	14	13	15	16	18	16
8" ø	3 ft	2.9	5.0	4.9	5.7	5.6	5.8	5.6
12" ø	6 ft	5.5	13	12	15	15	18	13
12" ø	3 ft	2.8	4.8	4.7	5.3	5.3	5.8	4.9

b. 90deg Elbow:

		63hz	125hz	250hz	500hz	1000hz	2000hz	4000hz
6" ø	6 ft	10	15	16	17	18	17	18
6" ø	3 ft	3.8	5.4	5.5	5.7	5.9	5.8	5.9
8" ø	6 ft	10	15	16	17	16	18	18
8" ø	3 ft	2.4	5.3	5.6	5.8	5.6	5.9	6.0
12" ø	6 ft	11	14	15	16	15	16	15
12" ø	3 ft	4.4	5.1	5.3	5.5	5.4	5.6	5.3

5. Usage:

- a. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.
- b. Connections to air inlets and outlets. Do not exceed [5'-0"] [6'-0" in length.
- c. Acceptable Manufacturers:
 - 1) Flexmaster USA - Type 6
 - 2) Thermaflex M-Ke

F. Radius Forming Elbows:

1. Flexible plastic radius forming elbow for use with flexible ducts to create 90deg elbow. One size for 6" to 16" diameter ducts. UL listed for return plenum spaces.
2. Usage: All supply air terminals with flexible ductwork connection.
3. Installation: Attach to flex duct and secure draw bands without crushing flex duct to form smooth radius elbow. Suspend radius forming elbow to structure. Install per manufacturer's instructions.
4. Acceptable Manufacturers:
 - a. Hart & Cooley - Smartflow
 - b. Thermaflex - Flexflow
 - c. Titus - Flexright

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide openings in ducts for thermometers and controllers.
- B. Locate ducts with space around equipment for normal operation and maintenance.
- C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.
- D. Provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork.
- E. Supply ductwork shall be free of construction debris, and shall comply with Level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.
- F. Repair all duct insulation and liner tears.
- G. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.
- H. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.
- I. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.
- J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.
- K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.
- L. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.
- M. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers unless coordinated with piping contractor prior to installation. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

3.2 DUCTWORK APPLICATION SCHEDULE

A. General:

1. Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual
2. Insulation:
 - a. Refer to Section 23 07 13 for insulation types.
 - b. Type A insulation (Flexible Fiberglass Wrap) R-values noted are based on installed values (25% compression).
3. Note 1: Apply aluminum based adhesive sealant tape at non-flanged joints on ducts serving dedicated outside air supply (DOAS) and exhaust system in addition to Class A sealant.

B. Exterior Supply Duct from Fan to Diffusers - Single Wall with Aluminum Jacket or Laminated Self-Adhering Flexible Aluminum Jacket:

1. Shape:
 - a. Rectangular Duct - Single Wall
 - b. Round and Flat Oval Spiral Seam Ductwork - Single Wall
2. Material: Galvanized Steel
3. Pressure Class: +3"
4. Seal Class: A
5. Insulation:
 - a. ASHRAE 90.1-2019: 2" thick Type B (R=8) with aluminum jacket or laminated self-adhering flexible aluminum jacket (R=8.0)

C. Return Duct:

1. Shape:
 - a. Rectangular Duct - Single Wall
 - b. Round and Flat Oval Spiral Seam Ductwork - Single Wall
2. Material: Galvanized Steel
3. Pressure Class: -2"
4. Seal Class: A
5. Insulation:

D. Exterior Return Duct:

1. Shape:
 - a. Rectangular Duct - Double Wall

2. Material: Galvanized Steel
3. Pressure Class: -2"
4. Seal Class: A
5. Insulation:
 - a. ASHRAE 90.1-2019: 2" thick Type B (R=8)
6. Additional Requirements: None

E. General Exhaust Duct:

1. Shape:
 - a. Rectangular Duct - Single Wall
 - b. Round and Flat Oval Spiral Seam Ductwork - Single Wall
2. Material: Galvanized Steel
3. Pressure Class: -1"
4. Seal Class: A
5. Insulation: None

F. Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.):

1. Insulation:
 - a. ASHRAE 90.1-2019: 1-1/2" thick Type A (R=4.5)

3.3 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.

- B. All ducts systems, regardless of pressure class, shall be Seal Class A as defined by Section 5-1 of SMACNA HVAC Air Duct Leakage Test Manual per the Energy Code, unless specifically noted otherwise. Seal Class A shall include sealing of all transverse joints, longitudinal seams, and duct wall penetrations with welds, gaskets, mastics, or fabric-embedded mastic system. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

- C. Double-wall ductwork: Install insulation end fittings at all transitions from double to single-wall construction.

3.4 TESTING

- A. Interior Duct - Less than 3" WG (positive or negative):

1. Leak testing of these pressure classes is not normally required for interior ductwork (inside the building envelope). However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

- B. Interior Duct - 3" WG and Above (positive or negative):

1. A minimum of 25% of interior ductwork (inside the building envelope) shall be tested. The Owner or designated representative shall select the sections to be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

- C. Exterior Duct - 1/2" WG and Above (positive or negative):

1. All exterior ductwork (outside the building envelope) shall be completely pressure tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

- D. Test Procedure:

1. Testing shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:
 - a. The required leakage class for Seal Class A, rectangular ducts, shall be 4; round shall be 2.
 - b. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.
 - c. All joints shall be felt by hand, and all discernible leaks shall be sealed.

- d. Totaling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.
- e. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.
- f. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.
- g. Positive pressure leakage testing is acceptable for negative pressure ductwork.

3.5 DUCTWORK PENETRATIONS

- A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.
- B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.
- C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install trim strip to cover vacant space and raw construction edges of all openings in finished rooms. Install escutcheon ring at all round duct openings in finished rooms. Trim strips and rings shall be same material and finish as exposed duct.

END OF SECTION

SECTION 23 31 50 - FABRIC DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fabric Ductwork

1.2 DESCRIPTION OF WORK

- A. Extent of non-metal ductwork is indicated on drawings and by requirements of this section.
- B. Types of non-metal ductwork required for this project include the following:
 - 1. Textile air dispersion products.

1.3 QUALITY ASSURANCE

- A. Building Codes and Standards:
 - 1. Product must be classified by Underwriter's Laboratories in accordance with the 25/50 flame spread / smoke developed requirements of NFPA 90-A and UL 2518.
 - 2. All product sections must be labeled with the logo and classification marking of Underwriter's Laboratories.
- B. Design and Quality Control:
 - 1. Manufacturer must have documented design support information including duct sizing; vent, orifice, and/or nozzle location; vent, orifice, and/or nozzle sizing; length; and suspension. Parameters for design, including maximum air temperature, velocity, pressure and textile permeability, shall be considered and documented.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications on materials and manufactured products used for work of this section.
- B. Building Code Data: Submit UL file number under which product is classified by Underwriter's Laboratories for both NFPA 90-A and UL 2518.
- C. Provide detailed drawings confirming configuration of fabric tensioning system (components, support locations, segment lengths) and textile dispersion system (diameter, lengths, airflow, pressure, and textile permeability).
- D. Provide detailed installation instructions for components to be installed.
- E. Provide warranty and maintenance documentation.

PART 2 - PRODUCTS

2.1 TEXTILE AIR DISPERSION SYSTEM

- A. Textile system to be constructed in modular lengths. Each segment and outlet shall be zipper connected.
- B. Pressure Range: Positive 0.25" w.c to 3.0" w.c. Temperature: 0degF and 180degF.
- C. Manufacturer must provide a 10-year product warranty for products supplied for the fabric portion of this system as well as a design and performance warranty.
- D. Manufacturer shall provide detailed drawings showing configuration of fabric tensioning system (components, support locations, segment lengths) and textile dispersion system (diameter, lengths, airflow, pressure, and textile permeability).
- E. Design Application: Educational - Athletics
- F. Fabric Type:
 - 1. Air-Porous: Fire retardant polyester, plain weave, coated, 6.8 oz/yd².
- G. Duct Configuration: Round.
- H. Integrated Outlets: Orifices.
- I. Suspension: Single cable with internal 360° hoop system, spaced on 5' centers.
- J. Color: Standard color as selected by Architect.
- K. Each section of the textile shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information.
- L. Accessories:
 - 1. End caps with zipper.
 - 2. Internal hoops to preserve round shape when partially or uninflated.
 - 3. Fabric duct shall be provided with tensioning device to adjust tension along length of fabric duct.
 - 4. Volume Dampers: Airflow balancing device factory preset and field adjustable.
- M. Acceptable Manufacturers:
 - 1. Duct-Sox or pre-approved alternate manufacturer

PART 3 - EXECUTION

3.1 INSTALLATION OF TEXTILE AIR DISPERSION SYSTEM

- A. Install chosen suspension system in accordance with the requirements of the manufacturer. Instructions for installation shall be provided by the manufacturer with the product.

3.2 CLEANING AND PROTECTION

- A. Clean air handling unit and ductwork prior to the fabric duct system installation unit-by-unit as it is installed. Clean external surfaces of foreign substances that may cause corrosive deterioration of facing.
- B. Temporary Closure: At ends of ducts that are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering that will keep the system clean until installation is completed.
- C. If fabric duct systems become soiled during installation, they shall be removed and cleaned following the manufacturer's standard terms of laundry.

END OF SECTION

SECTION 23 33 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual Volume Dampers.
- B. Duct Access Doors.
- C. Duct Test Holes.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit manufacturer's installation instructions.
- C. Submit certification that ductwork accessories will withstand seismic forces defined in Section 23 05 50. Include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

- A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.
- B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inches.
- C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.

- E. Provide locking quadrant regulators on single and multi-blade dampers.
- F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

2.2 DUCT ACCESS DOORS

- A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.
- B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment requiring service inside the duct.
- C. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
- D. Access doors with sheet metal screw fasteners are not acceptable.
- E. Minimum size for access doors shall be 24" x 16" or full duct size, whichever is less.
- F. Provide duct access door in all horizontal return ductwork at 20 foot intervals per NFPA 90A.

2.3 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.4 DUCTWORK ACCESSORY SEALANTS

- A. Ductwork accessory sealants and adhesives shall conform to Section 23 31 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install accessories in accordance with manufacturer's instructions.
 - 2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.
 - 3. Coordinate and install access doors provided by others.

4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24" x 24".
5. Provide duct test holes where indicated and as required for testing and balancing purposes.

B. Manual Volume Damper:

1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing. Use splitter dampers only where indicated.
2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote-controlled volume control device for operation of the damper. Coordinate location with the Architect/Engineer.

END OF SECTION

SECTION 23 37 00 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grilles And Registers.
- B. Architectural Square Panel Diffusers.

1.2 QUALITY ASSURANCE

- A. Test and rate performance of air inlets and outlets per ASHRAE 70.
- B. Test and rate performance of louvers per AMCA 500L-99.
- C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00.
- B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.
- C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.
- D. Submit manufacturer's installation instructions.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.
- B. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 AIR TERMINALS - GRILLES AND REGISTERS

- A. Reference to a grille means an air supply, exhaust or transfer device without a damper.
- B. Reference to a register means an air supply, exhaust or transfer device with a damper.

- C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.
- D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- E. The capacity and size of the unit shall be as shown on the drawings.
- F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect.
- G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.
- H. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.
- I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.
- J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.
- K. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.
- L. Manufacturers:
 - 1. Tuttle & Bailey
 - 2. Titus
 - 3. Price
 - 4. Nailor
 - 5. Carnes
 - 6. Metalaire
 - 7. Krueger
 - 8. Anemostat
 - 9. Raymon Donco

2.2 AIR TERMINALS - ARCHITECTURAL SQUARE PANEL DIFFUSERS

- A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.
- B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.

- C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- D. The capacity and size of the unit shall be as shown on the drawings.
- E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect. .
- F. Diffusers shall be architectural solid square panel and flush with ceiling.
- G. The exposed surface shall be smooth, flat and free of visible fasteners. The face panel shall be 22 gauge steel with a rolled edge or shall be 18 gauge with a smooth ground, uniform edge.
- H. The back pan shall be one piece 22 gauge stamped and shall include an integral inlet. (Welded inlets and corner joints are not acceptable).
- I. Diffusers with a 24x24 back pan shall have a minimum 18x18 face panel size. Diffusers with a 12x12 back pan shall have a minimum 9x9 face panel size.
- J. The face panel shall be mechanically fastened to the back panel with steel components. (Plastic fasteners are not acceptable.)
- K. Manufacturers:
 - 1. Tuttle & Bailey
 - 2. Titus
 - 3. Price
 - 4. Nailor
 - 5. Carnes
 - 6. Metalaire
 - 7. Krueger
 - 8. Anemostat
 - 9. Raymon Donco

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install items in accordance with manufacturers' instructions.
 - 2. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
 - 3. Install diffusers to ductwork with air tight connections.
 - 4. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.

5. Supply grille and register blades shall be aimed in the field to provide adequate air distribution in the space. All return grilles and registers blades shall be oriented to minimize sight distance beyond installed device.

B. Volume Damper:

1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.

C. Maintaining Duct Cleanliness:

1. When grilles, registers, and diffusers are installed, Contractor shall prevent construction dust, dirt, and debris from entering ductwork as required by Section 23 05 00.

END OF SECTION

SECTION 23 74 16.12 - PACKAGED ROOFTOP AIR CONDITIONING UNITS 25 TON AND
BELOW

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Packaged Rooftop Unit.
- B. Unit Controls.
- C. Roof Mounting Frame and Base.
- D. Economizers.

1.2 QUALITY ASSURANCE

- A. All insulation inside the unit and in the air stream must comply with the requirement of NFPA 90A (maximum flame spread of 25 and maximum smoke developed of 50).
- B. All units must be UL or ETL listed and must contain UL labeled components.
- C. Fans shall be tested and rated in cabinet in accordance with AMCA Standard 210. All fan assemblies shall be dynamically balanced in cabinet at final assembly.
- D. Conform to ASHRAE 90.1.
- E. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00.
- B. Indicate electrical service and duct connections on shop drawings or product data.
- C. Submit manufacturer's installation instructions.
- D. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- E. Provide 8 octave maximum sound power levels at unit discharge and return connection.
- F. Submit certification that the packaged rooftop air conditioning units, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from physical damage by storing off site until roof mounting frames are in place, ready for immediate installation of units.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, installation instructions, maintenance and repair data, and parts listing.

1.6 WARRANTY

- A. Provide five (5) year manufacturer's warranty for compressors.
- B. Provide standard year manufacturer's warranty for heat exchanger.
- C. Provide standard year manufacturer's warranty for controls and electrical components (thermostats, VFD, etc.).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: The scheduled manufacturer is the Basis of Design. The Contractor is responsible for all costs, schedule impacts, and construction coordination, including design costs and regulatory agency approvals, related to using a specified alternate product other than the Basis of Design. Refer to Section 23 05 00 for additional information.
- B. Trane
- C. York
- D. Daikin
- E. Valent

- F. Aaon

2.2 MANUFACTURED UNITS

- A. Provide ground mounted units having gas burner, and electric refrigeration.
- B. Unit shall be self-contained, packaged, factory assembled, pre-wired and tested, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, air filters, refrigerant cooling coil and compressor, condenser coil, condenser fan, and a full refrigerant charge.
- C. Unit shall be furnished with non-fused disconnect switch, short fuse protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection.

2.3 FABRICATION

- A. Cabinet: Galvanized steel with baked enamel finish, access doors or removable access panels with quick fasteners locking door handle type with piano hinges. Access doors shall be provided at each section (e.g., filter section, supply fan section, etc.). All exterior access panels must be permanently labeled on the outside indicating what is behind the panel. Structural members shall be minimum 18 gauge, with access doors or removable panels of minimum 20 gauge.
- B. Outside Air Intakes: The outside air intakes shall be located a minimum of 15 inches above the roof mounting curb to minimize the effect of heat pickup from the roof during the natural cooling cycle and the effects of snow on the roof during winter operation. Each air intake shall be furnished with rain eliminators.
- C. Insulation: Minimum of 1/2" thick, 1.5 lb./cu.ft. density coated glass fiber insulation on surfaces where conditioned air is handled. Protect edges from erosion.
- D. Heat Exchangers: Aluminized steel, of welded construction.
- E. Air Filters: Two inch thick glass fiber disposable media in metal frames.

2.4 FANS/MOTORS

- A. Fans:
 - 1. Supply Fans: centrifugal; SWSI plenum or vane axial fan.
 - 2. All fans shall be aluminum or composite construction with fan shaft: turned, ground and polished steel; keyed to wheel hub.
 - 3. Fan and motor assemblies shall be resiliently mounted.
 - 4. Direct drive motor.
 - 5. All fan bearings must be capable of being lubricated by easily accessible grease fittings.
 - 6. All fans must be statically and dynamically balanced.

B. Motors:

1. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.
2. No equipment shall be selected or operate above 90% of its motor nameplate rating.
3. Motor shall have 1.15 service factor.
4. ECM motors may be provided.

2.5 BURNER

- A. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shutoff pilot. Single stage
- B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.
- C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, or adjustable time delay relays with switch for continuous fan operation.

2.6 EVAPORATOR COIL

- A. Provide copper tube with aluminum fin coil assembly.
- B. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft² of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.
- C. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.
- D. Provide insulation on liquid refrigerant and suction piping between compressor and evaporator coil where not protected by drain pans. Insulation shall be elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1" thick per layer where multiple layers are specified.

2.7 COMPRESSOR

- A. Provide hermetic or semi-hermetic compressors (quantity as scheduled on drawings), 3600 rev/min maximum, resiliently mounted with positive lubrication, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.
- B. Five minute timed off circuit shall delay compressor start.
- C. Provide capacity control by providing inverter duty compressors.
- D. The use of hydrochlorofluorocarbon (HCFC) or chlorofluorocarbon (CFC) based refrigerants is prohibited.

2.8 CONDENSER

- A. Condenser shall provide design capacity between the minimum and maximum ambient conditions scheduled on the drawings.
- B. Condenser Coil:
 - 1. Round Copper Tube and Aluminum Fins: Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing. Air test under water to 450 psig.
 - 2. Microchannel: All aluminum brazed fin construction. The maximum allowable working pressure of the condenser is 450 psig. Air test under water to 450 psig.
- C. Condenser Fans: Provide direct drive low noise blade design propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be aluminum or composite material.
- D. Condenser Motors: Fan motors shall be an ECM type motor for proportional control. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.
- E. Entire fan assembly shall be statically and dynamically balanced.
- F. Provide refrigerant pressure switches to cycle condenser fans.
- G. Provide hail guards on all condenser coils.

2.9 MIXING SECTION

- A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper shall fail to closed position. Relief dampers may be gravity balanced.

- B. Gaskets: Provide tight fitting dampers with edge gaskets. Gaskets must be mechanically fastened (use of adhesive alone shall not be acceptable). Damper blades shall be gasketed with side seals to provide an air leakage rate of Class 1A at 1" w.c. pressure differential for a 24"x 24" damper. A barometric exhaust damper shall be provided to exhaust air out the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator.
- C. Damper Actuator: 24 volt with gear train sealed in oil, with spring return on units 7.5 tons cooling capacity and larger.

2.10 ECONOMIZERS

- A. Factory installed by approved rooftop unit manufacturer with fully modulating motorized outside air and return air dampers.
- B. To be controlled by differential enthalpy with fixed dry-bulb controller with minimum position setting.
- C. Shall be equipped with 100% capable relief barometric damper relieving up to 100% return air and sealed to meet ASHRAE 90.1 requirements.
- D. Shall be capable of introducing up to 100% outside air.
- E. Shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
- F. Dampers shall be capable of completely closing when unit is in unoccupied mode.
- G. Outside air damper normally closed and return air damper normally open.
- H. Provide factory installed and tested, outdoor air monitor that controls outdoor air \pm 15% accuracy down to 40 cfm per ton.
- I. Provide a field installed duct/space-mounted CO₂ sensor. Outside air damper position shall modulate between the demand control ventilation limit (minimum position setpoint) and the ventilation limit (maximum non-economizer position setpoint) to satisfy the space requirements. Damper position shall be controlled to the greater of the two command signals, either minimum outside airflow or space IAQ (CO₂).
- J. Economizer Fault Detection and Diagnostics (FDD):
 - 1. Air-cooled unitary direct-expansion units that are equipped with an economizer shall include a fault detection and diagnostics system complying with the following:
 - a. The following temperature sensors shall be permanently installed to monitor system operation:
 - 1) Outside air.

- 2) Supply air.
 - 3) Return air.
- b. Temperature sensors shall have an accuracy of $\pm 2^{\circ}\text{F}$ over the range of 40°F to 80°F .
 - c. Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.
 - d. The unit controller shall be configured to provide system status by indicating the following:
 - 1) Free cooling available.
 - 2) Economizer enabled.
 - 3) Compressor enabled.
 - 4) Heating enabled.
 - 5) Mixed air low limit cycle active.
 - 6) The current value of each sensor.
 - e. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans, and the heating system can be independently tested and verified.
 - f. The fault detection and diagnostics system shall be configured to detect the following faults:
 - 1) Air temperature sensor failure/fault.
 - 2) Not economizing when the unit should be economizing.
 - 3) Economizing when the unit should not be economizing.
 - 4) Damper not modulating.
 - 5) Excess outdoor air.
 - g. The unit shall be configured to report faults to a fault management application available for access by day-to-day operating or service personnel or annunciated locally on zone thermostats.

2.11 ELECTRICAL

- A. Provide with single point power connection to service all controls, dampers, outlet, and fans, complete with non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection, transformer, and convenience outlet.
- B. All units must be so constructed that when the electrical section access panel is opened, all electrical power to the unit (with the exception of the 120 volt duplex convenience outlet) is disconnected by means of a single disconnect.
- C. All wiring must be labeled, numbered, and terminate in "spade clips". All terminal strips must be keyed to the wiring numbers. Each control device must be permanently labeled to indicate its function.

- D. Wiring diagrams for all circuits must be permanently affixed to the inside of the electrical section access panel. The markings of terminal strips and wiring must agree with the numbering on the wiring diagrams.
- E. All units shall include a transformer for controls and convenience outlet.
- F. Only one power cable connection to the unit shall be necessary.
- G. Motor shall include phase failure protection and prevent the motor from operation in the event of phase loss.

2.12 OPERATING CONTROLS - SINGLE ZONE UNITS

- A. When ECM are applied:
 - 1. Single Zone VAV: The unit controller shall proportionally control the ECM motors on the supply fan based on space temperature. The unit controller shall increase/decrease the speed of the supply fan in order to maintain the space temperature within its setpoint and deadband. The unit controller shall provide discharge air temperature control with the compressor modulation.
- B. When variable speed drives are applied:
 - 1. Single Zone VAV: An electronic variable frequency drive shall be provided for the supply air fan. Each drive shall be factory installed out of the airstream in a conditioned cabinet. Drives shall meet UL Standard 95-5V. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly. Mounting arrangements that expose drives to high temperature unfiltered ambient air are not acceptable.
- C. Room thermostat shall incorporate:
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set-up for four separate temperatures per day.
 - 4. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - 5. Short cycle protection.
 - 6. Programming based on weekdays, Saturday and Sunday.
 - 7. Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.
- D. Room thermostat display shall include:
 - 1. Time of day.
 - 2. Actual room temperature.
 - 3. Programmed temperature.
 - 4. Programmed time.
 - 5. Duration of timed override.
 - 6. Day of week.

7. System model indication: heating, cooling, auto, off, fan auto, fan on.
8. Stage (heating or cooling) operation.

- E. Provide low limit sequence to close outside air dampers and stop supply fan.
- F. Mixed Air Controls: Maintain selected supply air temperature and revert dampers to minimum outside air position on a call for heating and above 75°F ambient, when ambient air enthalpy exceeds return air enthalpy.

2.13 DDC TEMPERATURE CONTROLS

- A. Install standalone control module providing communication between unit controls and packaged DDC temperature control system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings and illustrated by the manufacturer.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting curb and provide watertight enclosure to protect ductwork and utility services. Install unit level.
- C. All field wiring shall be in accordance with the National Electrical Code.
- D. P-traps must be provided for all drain pans.
- E. Comb all coils to repair bent fins.
- F. Contractor shall coordinate unit access stair and walkway placement to ensure compliance with OSHA requirements.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide initial start-up and shutdown during first year of operation.

END OF SECTION

SECTION 23 74 16.15 - PACKAGED ROOFTOP AIR CONDITIONING UNITS FOR DEDICATED
OUTSIDE AIR

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Packaged Rooftop Unit.
- B. Unit Controls.
- C. Roof Mounting Frame and Base.
- D. Heat Recovery.

1.2 QUALITY ASSURANCE

- A. All insulation inside the unit and in the air stream must comply with the requirement of NFPA 90A (maximum flame spread of 25 and maximum smoke developed of 50).
- B. All units must be UL or ETL listed and must contain UL labeled components.
- C. Fans shall be tested and rated in cabinet in accordance with AMCA Standard 210. All fan assemblies shall be dynamically balanced in cabinet at final assembly.
- D. Conform to ASHRAE 90.1.
- E. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00.
- B. Indicate electrical service and duct connections on shop drawings or product data.
- C. Submit manufacturer's installation instructions.
- D. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- E. Provide 8 octave maximum sound power levels at unit discharge and exhaust connection.
- F. Submit certification that the packaged rooftop air conditioning units, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from physical damage by storing off site until roof mounting frames are in place, ready for immediate installation of units.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, installation instructions, maintenance and repair data, and parts listing.

1.6 WARRANTY

- A. Provide five (5) year manufacturer's warranty for compressors.
- B. Provide standard year manufacturer's warranty for heat exchanger.
- C. Provide standard year manufacturer's warranty for controls and electrical components (thermostats, VFD, etc.).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: The scheduled manufacturer is the Basis of Design. The Contractor is responsible for all costs, schedule impacts, and construction coordination, including design costs and regulatory agency approvals, related to using a specified alternate product other than the Basis of Design. Refer to Section 23 05 00 for additional information.
- B. Trane
- C. York
- D. Daikin
- E. Valent

F. Aaon

2.2 MANUFACTURED UNITS

- A. Provide roof-mounted units having gas burner and electric refrigeration.
- B. Unit shall be self-contained, packaged, factory assembled, pre-wired and tested, consisting of cabinet and frame, supply fan, exhaust fan, heat exchanger and burner, controls, air filters, refrigerant cooling coil and compressor, condenser coil, condenser fan, and a full refrigerant charge.
- C. Unit shall be furnished with non-fused disconnect switch, short fuse protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection.

2.3 FABRICATION

- A. Cabinet: Galvanized steel with baked enamel finish, access doors with locking door handle with piano hinges. Access doors shall be provided at each section (e.g., filter section, supply fan section, etc.). All exterior access panels must be permanently labeled on the outside indicating what is behind the panel. Structural members shall be minimum 18 gauge, with access doors or removable panels of minimum 20 gauge.
- B. Outside Air Intakes: The outside air intakes shall be located a minimum of 15 inches above the roof mounting curb to minimize the effect of heat pickup from the roof during the natural cooling cycle and the effects of snow on the roof during winter operation. Each air intake shall be furnished with rain eliminators.
- C. Insulation: All sections shall be double wall, foam injected casings.
- D. Heat Exchangers: Stainless steel, of welded construction.
- E. Air Filters: Two inch thick glass fiber disposable media in metal frames.

2.4 Heat Recovery:

- A. Heat wheel.

2.5 FANS/MOTORS

- A. Fans:
 - 1. Supply Fans: Airfoil DWDI centrifugal; SWSI plenum or vane axial fan.
 - 2. Exhaust Fans: Airfoil DWDI centrifugal; SWSI plenum or vane axial fan.
 - 3. All fans shall be aluminum or composite construction with fan shaft: turned, ground and polished steel; keyed to wheel hub.
 - 4. Fan and motor assemblies shall be resiliently mounted.
 - 5. Direct drive motor.
 - 6. All fan bearings must be capable of being lubricated by easily accessible grease fittings.
 - 7. All fans must be statically and dynamically balanced.

B. Motors:

1. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.
2. No equipment shall be selected or operate above 90% of its motor nameplate rating.
3. Motor shall have 1.15 service factor.
4. ECM motors may be provided.

2.6 BURNER

- A. Gas Burner: Forced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shutoff pilot. Fully modulating gas valve with minimum 10:1 turndown. The burner shall operate efficiently at all firing rates. The burner shall have proven open damper low-high-low pre-purge cycle and proven low fire start. The combustion air control damper shall be in the closed position during the off cycle to reduce losses.
- B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.
- C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, or adjustable time delay relays with switch for continuous fan operation.

2.7 EVAPORATOR COIL

- A. Provide copper tube with aluminum fin coil assembly.
- B. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft² of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.
- C. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.
- D. Provide insulation on liquid refrigerant and suction piping between compressor and evaporator coil where not protected by drain pans. Insulation shall be elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1" thick per layer where multiple layers are specified.

- E. Drain Pan Condensate Overflow Switch: Float with integral magnet overflow switch conforming to UL508. Factory installed in drain pan and wired to shut the rooftop unit down with a fault alarm. No standby power required.

2.8 HOT GAS REHEAT COIL

- A. Provide copper tube with aluminum fin coil assembly.
- B. Valves to reroute hot refrigerant gas from the discharge line of the compressor through the reheat coil.

2.9 COMPRESSOR

- A. Provide hermetic or semi-hermetic compressors (quantity as scheduled on drawings), 3600 rev/min maximum, resiliently mounted with positive lubrication high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.
- B. Five minute timed off circuit shall delay compressor start.
- C. Provide capacity control by providing inverter duty compressors.
- D. The use of hydrochlorofluorocarbon (HCFC) or chlorofluorocarbon (CFC) based refrigerants is prohibited.

2.10 CONDENSER

- A. Condenser shall provide design capacity between the minimum and maximum ambient conditions scheduled on the drawings.
- B. Condenser Coil:
 - 1. Round Copper Tube and Aluminum Fins: Construct condenser coils of aluminum fins mechanically bonded to seamless copper tubing. Air test under water to 450 psig (3100 kPa gauge).
 - 2. Microchannel: All aluminum brazed fin construction. The maximum allowable working pressure of the condenser is 450 psig (3100 kPa gauge). Air test under water to 450 psig (3100 kPa gauge).
- C. Condenser Fans: Provide direct drive low noise blade design propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be aluminum or composite material.
- D. Condenser Motors: Fan motors shall be an ECM type motor for proportional control. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

- E. Entire fan assembly shall be statically and dynamically balanced.
- F. Provide refrigerant pressure switches to cycle condenser fans.
- G. Provide hail guards on all condenser coils.

2.11 HEAT RECOVERY

A. Heat Wheel:

1. Heat Recovery Device: Heat Wheel - Aluminum Substrate with 4 Angstrom Molecular Sieve Desiccant:
 - a. Energy recovery shall be an integral part of unit from the manufacturer. No field assembly, ducting, or wiring shall be required with the energy recovery option.
 - b. Energy recovery media shall be accessible through a 2" thick, foam-injected, double-wall, hinged access door with quarter-turn latches.
 - c. Energy recovery shall be provided through a total enthalpy wheel providing sensible and latent energy transfer per the scheduled performance.
 - d. Energy recovery wheel media shall be constructed of fluted aluminum with permanently-bonded zeolite desiccant.
 - e. Energy recovery wheel cassette shall be mounted perpendicular (90°) to the base of the unit.
 - f. A VFD shall be required to modulate the speed of the wheel and to provide soft start to extend the life of the belt.
 - g. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours.
 - h. Rotor media shall be reinforced using aluminum structural spokes with extruded central hub and shaft and shall be connected to shaft using pillow bearings.
 - i. Energy wheel cassette shall include seals, drive motor, and linked drive belt.
 - j. Latent energy shall be transferred entirely in the vapor phase with no condensation.
 - k. The energy recovery cassette and wheel drive motor shall be an Underwriters Laboratories recognized component for electrical and fire safety.
 - l. Thermal performance shall be certified by the wheel manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment.

2.12 ELECTRICAL

- A. Provide with single point power connection to service all controls, dampers, outlet, and fans, complete with non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection, transformer, and convenience outlet. All units must be so constructed that when the electrical section access panel is opened, all electrical power to the unit (with the exception of the 120 volt duplex convenience outlet) is disconnected by means of a single disconnect.
- B. All wiring must be labeled, numbered, and terminate in "spade clips". All terminal strips must be keyed to the wiring numbers. Each control device must be permanently labeled to indicate its function.

- C. Wiring diagrams for all circuits must be permanently affixed to the inside of the electrical section access panel. The markings of terminal strips and wiring must agree with the numbering on the wiring diagrams.
- D. All units shall include a transformer for controls and convenience outlet.
- E. Only one power cable connection to the unit shall be necessary.
- F. Motor shall include phase failure protection and prevent the motor from operation in the event of phase loss.

2.13 OPERATING CONTROLS - CONSTANT VOLUME DOAS UNITS

- A. When ECMs are applied:
 - 1. Constant Volume: The unit controller shall proportionally control the ECM motors on each fan based on initial airflow settings. The unit controller shall increase/decrease the speed of the supply fan in order to maintain the constant volume airflow. The unit controller shall provide discharge air temperature control with the compressor modulation.
- B. When variable speed drives are applied:
 - 1. Constant Volume: An electronic variable frequency drive shall be provided to balance each fan. Each drive shall be factory installed out of the airstream in a conditioned cabinet. Drives shall meet UL Standard 95-5V. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly. Mounting arrangements that expose drives to high temperature unfiltered ambient air are not acceptable.
- C. Room thermostat shall incorporate:
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from setpoint.
 - 3. Set-up for four separate temperatures per day.
 - 4. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - 5. Short cycle protection.
 - 6. Programming based on weekdays, Saturday and Sunday.
 - 7. Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.
- D. Controller display shall include:
 - 1. Time of day.
 - 2. Supply duct temperature.
 - 3. Programmed temperature.
 - 4. Programmed time.
 - 5. Duration of timed override.
 - 6. Day of week.

7. System model indication: heating, cooling, auto, off, fan auto, fan on.
8. Stage (heating or cooling) operation.

- E. Provide low limit sequence to close outside air dampers and stop fans.
- F. Dehumidification Controls: Maintain the relative humidity setpoint with the hot refrigerant gas reheat coil.

2.14 DDC TEMPERATURE CONTROLS

- A. Install standalone control module providing communication between unit controls and packaged DDC temperature control system.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings and illustrated by the manufacturer.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting curb and provide watertight enclosure to protect ductwork and utility services. Install unit level.
- C. All field wiring shall be in accordance with the National Electrical Code.
- D. P-traps must be provided for all drain pans.
- E. Comb all coils to repair bent fins.
- F. Contractor shall coordinate unit access stair and walkway placement to ensure compliance with OSHA requirements.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide initial start-up and shutdown during first year of operation.

END OF SECTION

SECTION 23 82 00 - TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Architectural Electric Wall Heaters.

1.2 QUALITY ASSURANCE

- A. All filters shall be UL listed Class 1 or Class 2.
- B. All electrical equipment shall have a UL label.
- C. All louvers and dampers shall have AMCA certified ratings.
- D. Factory wired equipment shall conform to ANSI/NFPA 70.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00.
- B. Submit catalog data including arrangements, cross sections of cabinets, grilles, bracing, typical elevations.
- C. Submit schedules of equipment and enclosures indicating length, number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, and comparison of specified to actual heat output.
- D. Indicate mechanical and electrical service locations and requirements. Show deviations from scheduled products.
- E. Submit manufacturers' installation instructions.
- F. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.
- G. Submit certification that terminal heat transfer units, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ASHRAE 90.1.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's operation and maintenance data. Include operating, installation, maintenance and repair data, and parts listings.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL ELECTRIC WALL HEATERS

- A. Assembly: UL listed and labeled with terminal box and cover, fan guard, and built-in controls. Draw-through design. Provide with baked enamel finished steel back box suitable for wall mounting.
- B. Heating Elements: Nickel-chromium resistance wire enclosed in a steel sheath with copper brazed plate fins.
- C. Cabinet: Minimum 20 gauge steel with baked enamel finish. Provide surface mount, semi-recessed or fully recessed cabinet as called for on drawings.
- D. Front Panel: Bar grille constructed of minimum 16 gauge cold-rolled steel, welded into a uniform grille and finished in baked enamel. Front grille shall have a satin finished aluminum frame around the periphery.
- E. Fan: Direct drive propeller type, statically and dynamically balanced.
- F. Motor: Permanently lubricated sleeve bearings, totally enclosed, automatic reset thermal overload protection.
- G. Control: Unit-mounted tamper-proof thermostat, thermal cutout, double-pole single throw unit mounted disconnect covered by protective front panel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturers' instructions.
2. Coordinate recess sizes for recessed equipment.
3. Protect units with protective covers during construction.
4. Comb all coils to repair bent fins.

3.2 CLEANING

- A. After construction is complete, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by manufacturer.
- C. Install new filters.

END OF SECTION

SECTION 26 05 00 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

- A. 2020 NFPA 70 - National Electrical Code (NEC)

1.3 SCOPE OF WORK

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Electrical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Description of Systems shall be as follows:
 - 1. Electrical power system to and including luminaires, equipment, motors, devices, etc.
 - 2. Grounding system.
 - 3. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
- E. Work Not Included:
 - 1. Telecommunications cabling will be by others, in raceways and conduits furnished and installed as part of the Electrical work.
 - 2. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

1.4 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours are required.

1.5 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, and CONTROL CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.
3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.
5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.
7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.
8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
9. Low Voltage Technology Wiring: The wiring associated with the technology systems, used for analog or digital signals between equipment.

10. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications/technology information outlets.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Luminaires.
 - b. Sheet metal.
 - c. Other piping.
 - d. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.
3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.
2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.

3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.
2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.6 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign-off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.7 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.
2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City Mount Carmel, Illinois Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of Illinois Eastern Community Colleges.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. If there are no local codes having jurisdiction, the current issue of the National Electrical Code shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.
8. Pay all telephone company charges related to the service or change in service.

E. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.
3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.
7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better-quality number shall govern.
8. Where used in electrical documents the word "furnish" shall mean supply for use, the word "install" shall mean connect up complete and ready for operation, and the word "provide" shall mean to supply for use and connect up complete and ready for operation.
9. Any item listed as furnished shall also be installed unless otherwise noted.
10. Any item listed as installed shall also be furnished unless otherwise noted.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.8 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item	Coordination Drawing
26 05 73	Power System Study	
26 09 33	Lighting Control System	
26 24 16	Panelboards	YES
26 27 26	Wiring Devices	yes
26 28 16	Disconnect Switches	yes
26 51 19	LED Lighting	Yes
26 12 19	Pad Mounted, Liquid Filled Transformers	Yes
26 13 14	Pad Mounted Medium Voltage Switchgear	Yes

B. Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
- g. Description of item submitted (using project nomenclature) and relevant specification number

- h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

- e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
- a. Allow at least two weeks for Architect/Engineer's review and processing of each submittal, excluding mailing.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

- 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
- 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 26 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 26 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.9 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 1.
- B. Format:
 1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
 2. Submit in Excel format.
 3. Support values given with substantiating data.
- C. Preparation:
 1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
 2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
 3. Itemize the cost for each of the following:
 - a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.
 4. For each line item having an installed cost of more than \$5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:
 - a. Each piece of equipment requiring shop drawings. Use the equipment nomenclature (SB-1, PANEL P-1, etc.) on the Schedule of Values.

- b. Each type of small unitary equipment (e.g., FDS, FCS, CS, etc.). Multiple units of the same type can be listed together provided quantities are also listed so unit costs can be determined.
- c. Each conduit system (medium voltage, normal, emergency, low voltage systems, etc.). In addition, for larger projects breakdown the material and labor for each conduit system based on geography (building, floor, and/or wing).
- d. Fire alarm broken down into material and labor for the following:
 - 1) Engineering
 - 2) Controllers, devices, sensors, etc.
 - 3) Conduit
 - 4) Wiring
 - 5) Programming
 - 6) Commissioning
- e. Site utilities (5' beyond building)
- f. Seismic design
- g. Testing
- h. Commissioning
- i. Record drawings
- j. Punchlist and closeout

D. Update Schedule of Values when:

- 1. Indicated by Architect/Engineer.
- 2. Change of subcontractor or supplier occurs.
- 3. Change of product or equipment occurs.

1.10 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.11 PRODUCT DELIVERY, STORAGE, HANDLING and MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- B. Keep all materials clean, dry and free from damaging environments.

- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.12 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.
- B. The following network connected equipment shall be equipped with restricted access protocols:
 - 1. Adjustable trip overcurrent protection devices
 - 2. Power monitoring and control
 - 3. Electrical controls
 - 4. Lighting control system
 - 5. Variable frequency drives

1.13 WARRANTY

- A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.14 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.15 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on the Contractors part or on the part of other Contractors whose work is affected.
- E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

2.2 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

2.3 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with the work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the Architect/Engineer or their representative, and do no further work until the Architect/Engineer or their representative gives further instructions.
9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.

10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.
11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.
12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.
2. Provide all necessary sand and/or CA6 for backfilling.
3. Native soil materials may be used as backfill if approved by the Geotechnical Engineer.
4. Dispose of the excess excavated earth as directed.
5. Backfill materials (native soil material, sand, and/or CA6) shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.
6. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.
7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6" uniform horizontal layers with each layer compacted separately to required density.
8. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.
9. Backfill with native soil material (if approved) or sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.
10. Place all backfill above the sand in uniform layers not exceeding 6" deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.

11. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
12. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6" of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

2.4 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical Identification.
 - b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and operational.
 - c. Luminaire whips are supported above the ceiling.
 - d. Conduit identification is installed in accordance with Section 26 05 53 Electrical Identification.
 - e. Luminaires are suspended independently of the ceiling system when required by these contract documents.
 - f. All wall penetrations have been sealed.

2. To prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until full access has been provided.

2.5 PROJECT CLOSEOUT

A. Final Jobsite Observation:

1. To prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.
2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor's final payment.
4. Contractor shall notify Architect/Engineer 48 hours prior to installation of ceilings or lay-in ceiling tiles.

B. The following must be submitted before Architect/Engineer recommends final payment:

1. Operation and maintenance manuals with copies of approved shop drawings.
2. Record documents including marked-up or reproducible drawings and specifications.
3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.
4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and submit receipt to Architect/Engineer.
5. Inspection and testing report by the fire alarm system manufacturer.
6. Start-up reports on all equipment requiring a factory installation or start-up.

C. Circuit Directories:

1. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEIPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

2.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. The instructions shall include:
 - 1. Maintenance of equipment.
 - 2. Start-up procedures for all major equipment.
 - 3. Description of emergency system operation.
- E. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- F. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.
- G. Operating Instructions:
 - 1. Contractor is responsible for all instructions to the Owner's representatives for the electrical and specialized systems.
 - 2. If the Contractor does not have staff that can adequately provide the required instructions, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

2.7 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.
- F. Record actual routing of conduits exceeding 2 inches.

2.8 PAINTING

- A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.
- B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.
- C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.
- D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect the color preference before ordering.

2.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

2.10 SPECIAL REQUIREMENTS

- A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.
- B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner's representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's expense.

D. Raceway and Cable Routing Restrictions: Raceways and cable are restricted from being routed in the following locations, unless serving the space or permitted by the authority having jurisdiction.

1. Exit enclosures.
2. Other areas restricted by code.

2.11 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Within the Limits of Construction:

1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.
2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.

B. Outside the Limits of Construction:

1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.
2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.
3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.

C. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. General Contractor shall erect and maintain dust barriers throughout the construction work. These barriers shall be reasonably airtight and shall prevent entry into the construction zone by unauthorized persons. Reasonably airtight means construction equivalent to full-height temporary or permanent walls with joints taped or sealed, and shafts and other penetrations sealed as well as possible. Fire resistant polyethylene is acceptable; if flame spread/smoke developed ratings are demonstrated to conform to the applicable building codes and licensing acts.
2. The Contractor shall continuously maintain the construction zone under a negative pressure of at least 0.01" w.g. minimum relative to all adjacent areas of the building.
 - a. Exhaust fans used for this purpose shall filter air and discharge it outdoors or to the least populated area adjacent to the construction work using negative air machines designed specifically for this purpose. All filtration for air recirculated back into the building shall be HEPA (99.97% DOP efficiency) for work adjacent to healthcare or elderly facilities. If no work is adjacent to these areas, 95% filtration is acceptable. Filtering air discharged to outdoors shall be accomplished with 30% filters.

- b. If air is discharged outdoors, maintain all required distances to doors, windows, air intakes, etc.
 - c. If high levels of Volatile Organic Compounds (VOC's) or odors are released, activated carbon or equivalent filtration shall also be employed. Exhaust shall not discharge near doors, air intakes, pedestrians, gathering areas, or operable windows.
 - d. Adjusting existing air handling equipment to assist in pressure control is acceptable, if approved by the Owner and the authority having jurisdiction.
 - e. Seal return, exhaust, and supply air openings in or near the construction zone that serve existing air handling systems, and rebalance the systems for proper operation. If this is impractical, add filters at the intakes of sufficient cross sectional area to minimize the pressure drop and avoid the need for rebalancing.
 - f. Maintain pressure control one hour before and after all construction periods, and 24 hours per day in healthcare or elderly facilities.
3. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
 - a. Minimizing the amount of dust generated.
 - b. Reducing solvent fumes and VOC emissions.
 - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
 4. Request that the Owner designate an IAQ representative.
 5. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
 6. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
 7. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
 8. Request copies of and follow all Owner's IAQ and infection control policies.
 9. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
 10. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
 11. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings under Construction".

2.12 SYSTEM STARTING AND ADJUSTING

- A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.

- C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.
- D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

2.13 FIELD QUALITY CONTROL

A. General:

1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.
2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.
3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.
5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than Electrical Code Standards. Take readings between conductors, and between conductors and ground.
6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Ground Resistance:

1. Conduct service ground resistance tests using an approved manufactured ground resistance meter. Submit to the Architect/Engineer a proposed test procedure including type of equipment to be used. (The conventional ohmmeter is not an acceptable device.)
2. Make ground resistance measurements during normal dry weather and not less than 48 hours after a rain. Ground resistance values shall be verified by the Architect/Engineer at the time the readings are taken.
3. If the ground resistance value obtained is more than the value set forth in Section 26 05 26, the following shall be done to obtain the value given:
 - a. Verify that all connections in the service ground system are secure.

- b. Increase the depth to which ground rods are driven by adding section lengths to the rods and retest. If the resistance is still excessive increase the depth by adding an additional rod section and retest.
 - c. If the resistance is still excessive, furnish and install additional ground rods, spaced not less than 20 feet from other ground rods unless otherwise noted on plans, and connect into the ground electrode system. Retest.
 - d. Review results with the Architect/Engineer.
 - 4. Before final payment is made to the Contractor submit a written report to the Architect/Engineer including the following:
 - a. Date of test.
 - b. Number of hours since the last rain.
 - c. Soil condition at the time of the test in the ground electrode location. That is: dry, wet, moist, sand, clay, etc.
 - d. Diagram of the test set-up showing distances between test equipment, ground electrode, auxiliary electrodes, etc.
 - e. Make, model, and calibration date of test equipment.
 - f. Tabulation of measurements taken and calculations made.
- C. Ground-Fault Equipment Performance Testing:
- 1. Test: Perform ground-fault performance testing when system is installed. The test process shall use primary current injection per manufacturer instruction and procedures. Perform test for the following:
 - a. Solid state molded case circuit breakers and solid-state insulated case circuit breakers equipped with ground fault protection.
 - b. Fusible switches with ground fault relay protection.
 - c. Outside branch circuits and feeders.
 - d. Code required.
 - 2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.
- D. Other Equipment:
- 1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.
- E. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
4. Per Section 26 05 00, cable insulation test results have been submitted.
6. Per Section 26 05 00, ground resistance test results have been submitted.
7. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
8. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
9. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.
11. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

SECTION 26 05 13 - WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire
- B. Cabling for remote control, signal, and power limited circuits

1.2 RELATED WORK

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)
- B. UL 83 - Thermoplastic-Insulated Wires and Cables
- C. UL 854 - Service-Entrance Cables
- D. UL 1581 - Standard for Electrical Wires, Cables, and Flexible Cords

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Feeders and Branch Circuits 8 AWG and larger: Copper, stranded conductor, 600-volt insulation, THHN/THWN or XHHW-2.
- B. Feeders and Branch Circuits 8 AWG and larger in Underground Conduit: Copper, stranded conductor, 600-volt insulation, THWN or XHHW-2.
- C. Feeders and Branch Circuits 10 AWG and Smaller: Copper, solid or stranded conductor, 600-volt insulation, THHN/THWN, unless otherwise noted on the drawings.
- D. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.
- E. Each 120 volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

2.2 CABLING FOR REMOTE CONTROL, SIGNAL, AND POWER LIMITED CIRCUITS

- A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed.
 - 1. Low voltage switching and lighting control.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

- A. Above Accessible Ceilings:
 - 1. Building wire shall be installed in raceway.
- B. All Other Locations: Building wire in raceway.
- C. Above Grade: All conductors installed above grade shall be type "THHN".
- D. Underground or In Slab: All conductors shall be type "THWN".
- E. Low Voltage Cable (less than 100 volts): Low voltage cables in ducts, plenums, and other air handling spaces shall be plenum listed. Low voltage cables in non-accessible areas shall be installed in conduit. Low voltage cable may be installed without conduit in accessible areas using the following types of cable supports. Cable support types/systems shall comply with the warranty requirements of the low voltage cable manufacturer.
 - 1. J-hooks
 - 2. Bridle rings with saddle supports

3.2 CONTRACTOR CHANGES

- A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, Service entrance conductors are based on copper conductor installed in underground electrical ducts.
- B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.
- C. Conductor length(s) listed on plans and schedules. The drawings are diagrammatic with intent to convey the components of the electrical distribution system. Conductor length(s) when listed on plans and schedules are for engineering calculation purposes. Conductor length(s) shall NOT be used for bidding purposes.
- D. Record drawing shall include the calculations and sketches.

3.3 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use no wire smaller than 18 AWG for low voltage control wiring below 100 volts.
- C. Use 10 AWG conductor for 20 ampere, 120-volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277-volt branch circuit home runs longer than 200 feet.
- D. Use no wire smaller than 8 AWG for outdoor lighting circuits.
- E. The ampacity of multiple conductors in one conduit shall be derated per the Electrical Code. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.
- F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.
- G. Splice only in junction or outlet boxes.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- I. Make conductor lengths for parallel circuits equal.
- J. All conductors shall be continuous in conduit from last outlet to their termination.
- K. Terminate all spare conductors on terminal blocks, and label the spare conductors.
- L. Cables or wires shall not be laid out on the ground before pulling.
- M. Cables or wires shall not be dragged over earth or paving.
- N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.
- O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.
- P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.4 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

- C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through raceway.
- D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.
- E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.
- F. Only nylon rope shall be permitted to pull cables into conduit and ducts.
- G. Completely and thoroughly swab raceway system before installing conductors.

3.5 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage.
- B. Use suitable cable fittings and connectors.
- C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in accordance with the manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", recognized industry standards; and coordinated with other contractors.
- D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables.
- E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.
- F. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet. All J-hooks shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be independently rigidly attached to a structural element. J-hooks shall be installed to provide 2" horizontal separation and 6" vertical separation between systems.
- G. Open cable shall only be installed where specifically shown on the drawings, or permitted in these specifications.

3.6 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice and tap only in accessible junction boxes.
- B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.
- C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.
- D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- E. Use compression connectors applied with circumferential crimp for conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.
- I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:
 - 1. Facing the front and operating side of the equipment, the phase identification shall be:
 - a. Left to Right - A-B-C
 - b. Top to Bottom - A-B-C
- J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

3.7 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Building Wire and Power Cable Testing: Perform an insulation-resistance test on each conductor with respect to ground and adjacent conductors. Test shall be made by means of a low-resistance ohmmeter, such as a "Megger". The applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. The test duration shall be one minute. Insulation resistance must be greater than 100 mega-ohm for 600 volt and 25 mega-ohm for 300 volt rated cables per NETA Acceptance Testing Standard. Verify uniform resistance of parallel conductors.

- C. Inspect wire and cable for physical damage and proper connection.
- D. Torque test conductor connections and terminations to manufacturer's recommended values.
- E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- F. Provide documentation of the manufacturer's recommended lug torque value for copper conductors, the date the lugs were torqued, and installed torque readings. Documentation indicating that the torque wrench has been calibrated not more than 30 days prior to tightening of lugs shall be provided.
- G. Protection of wire and cable from foreign materials:
 - 1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.
- H. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

END OF SECTION

SECTION 26 05 15 - MEDIUM-VOLTAGE CABLE AND ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Medium voltage power cable
- B. Cable terminations
- C. Medium voltage cable splices
- D. Medium voltage testing

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in medium voltage cable and accessories with minimum five (5) years documented experience.
- B. Installer: The installing company shall employ personnel with a minimum of five (5) years documented experience in medium voltage cable installation. Resumes shall be submitted documenting the experience of all personnel pulling, splicing, terminating and testing the medium voltage cable.

1.3 REFERENCES

- A. AEIC CS8 (Association of Edison Illuminating Companies) - Specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46 KV
- B. ANSI/IEEE C2 - National Electrical Safety Code
- C. ICEA S-93-639 (Insulated Cable Engineers Association) / NEMA WC74 - 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy
- D. ICEA S-94-649 - Standard for Concentric Neutral Cables Rated 5 Through 46 KV
- E. ICEA S-97-682 - Standard for Utility Shielded Power Cables Rated 5 Through 46 KV
- F. IEEE 48 - Standard for Test Procedures and Requirements Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV
- G. IEEE 386 - Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V
- H. IEEE 404 - Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5 kV to 500 kV

- I. International Electrical Testing Association Ó Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (refer to the medium voltage cable DC testing requirements)
- J. NFPA 70 - National Electrical Code (NEC)
- K. UL 1072 - Standard for Medium-Voltage Power Cables

1.4 SUBMITTALS

- A. Submit product data under the provisions of Section 26 05 00.
- B. Submit product data indicating cable and accessory construction, materials, and ratings.
- C. Submit manufacturer's installation instructions under provisions of Section 26 05 00.
- D. Submit manufacturer's statement that medium voltage cable meets or exceeds specified requirements.
- E. Submit contractor qualification resumes documenting requirement specified in QUALITY ASSURANCE heading of this specification section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Store and protect products under provisions of Section 26 05 00.
- C. Accept cable and accessories on site in manufacturer's packages and inspect for damage.
- D. Protect cable and accessories from weather by covering with opaque plastic or canvas; provide ventilation to prevent condensation.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Section 26 05 00.
- B. Accurately record exact sizes and locations of cables.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cable product supplied shall be stated by its manufacturer to be suitable for the application for which it will be installed and used, as indicated on project drawings. This includes, but is not limited to, the following applications as permitted by the National Electric Code.
 - 1. Use indoors and/or outdoors.

2. Installation in wet and/or dry locations.
3. Use in conduits. Where installed in conduits, the cable manufacturer's product supplied shall be suitable for the conduit sizes specified on the project drawings. Where a manufacturer's cable size is recommended by a given manufacturer to be installed in a larger conduit or underground duct and other acceptable manufacturers' cables are available and the other acceptable manufacturers allow installation of their cables within the drawing conduit sizes and underground duct sizes, cables that work with the conduit sizes and underground duct sizes shown on project drawings shall be supplied.
4. Direct buried installations of cable.

B. Manufacturers:

1. The Okonite Company
2. Southwire
3. Prysmian (USA)
4. General Cable
5. The Kerite Company
6. Aetna Insulated Wire

2.2 MEDIUM VOLTAGE POWER CABLE

- A. Cable: Insulated, shielded cable rated 15 KV.
- B. Electrical Code medium voltage, solid dielectric "Type Letter" shall be MV-105.
- C. "Single" or "multi-conductor" cables shall be supplied as indicated on project drawings. Multi-conductor cables shall include full size ground conductors.
- D. Conductors shall be copper compact stranded or compressed stranded.
- E. The cable shall have a semi-conducting shield layer between the metal conductor and insulation layer as a strand screen.
- F. Insulation: Ethylene-propylene rubber (EPR), 133% insulation level. 15 KV rated cable shall have a minimum of 175 mils of insulation for 100 percent insulated cable and a minimum of 220 mils for 133 percent insulated cable.
- G. The cable shall have a semi-conducting shield layer over the insulation. The cable shall have a helically applied copper tape metallic shield over previously described layers. The tape shield shall be a minimum of 5 mils thick with a 25 percent overlap.
- H. The cable shall have an overall outer moisture and sunlight resistant PVC jacket.

2.3 MANUFACTURERS - CABLE TERMINATIONS AND CABLE SPLICES

- A. 3M Company
- B. Tyco Electronics (TE Connectivity, Raychem)

- C. Elastimold / Thomas & Betts
- D. Cooper
- E. Prysmian Group

2.4 CABLE TERMINATIONS

- A. Medium voltage cable termination types shall be suitable for the equipment or device to which the medium voltage cable is being terminated may be selected from the types described in this specification, given the suitable type is acceptable per the equipment or device manufacturer to which the cable is being terminated. The supplied termination shall be rated for the outdoor location in which it is being installed and applied. The supplied termination shall also be rated by its manufacturer for the exact type and size of cable to which the termination shall be applied.
- B. Cold Shrink Terminations: Termination kits shall meet the requirements of IEEE Standard 48 for Class 1 terminations. Termination shall be installed per the manufacturer's instructions by certified installers who have received authorized training from the manufacturer. Terminations installed on type MC armored cable shall include re-jacketing materials to cover any exposed cable shield from the point where the outer MC armor sheath terminates to where the medium voltage termination kit is applied.
- C. 200 Amp Loadbreak Cable Connectors: IEEE 386 type termination. Cable termination loadbreak elbow connectors, one per each single conductor phase cable. Connectors rated at 200 amps and, as a minimum, rated for the voltage class of the cable and equipment/devices to which the cable is connected. 15 KV rated terminations may be shown and required for 5KV equipment applications. 25 KV rated terminations may be shown and required for 15 KV equipment applications. The loadbreak elbow shall be installed per the manufacturer's instructions. The loadbreak elbow shall work with a corresponding 200-amp loadbreak, IEEE 386 type bushing insert that has been factory supplied and installed. The equipment bushing inserts shall be provided as part of the cable terminations and field installed on the equipment/device if not factory furnished.
- D. 600 Amp Deadbreak Cable Connectors: IEEE 386 type termination. Cable termination deadbreak connector, one per each single conductor phase cable. Connectors rated at 600 amps and rated for the voltage class of the cable and equipment/devices to which the cable is connected. **THIS CONNECTOR IS NOT INTENDED TO BE DISCONNECTED WHILE ENERGIZED.** Connector shall be installed per the manufacturer's instructions. The deadbreak connector shall work with a corresponding 600-amp, IEEE 386 type deadbreak equipment bushing that has been factory supplied and installed. The IEEE 386 type, 600-amp equipment bushings shall be provided as part of the cable terminations and field installed on the equipment/device if not factory furnished.

2.5 CABLE SPLICES

- A. Modular splicing systems, fully shielded, with 600-amp continuous current rated separable, bolted connectors that meet the requirements of ANSI/IEEE Standard 386. The splicing kits shall be suitable for use on 5, 8, 15, and 25 kV shielded power cables. Kits supplied shall have cable adapters to match the type of cable, such as tape-shielded, wire shielded, or cable with a jacketed concentric neutral. A capacitive test point on the connector insulating plug shall provide a safe means of testing the circuit without disturbing the bolted connection. The completed installation shall be fully shielded to provide a complete deadfront connection that is suitable for operation submerged or in direct buried locations. The splice system shall be able to expand to connect two, three, or four conductors.
1. Provide modular splices with the following voltage ratings and characteristics in accordance with ANSI/IEEE Standard 386 for use with 25 kV or less rated cables. Cables over 25 kV shall use splice kits rated by the splice kit manufacturer for the voltage and current ratings of the cable, with detailed voltage rating parameters supplied by the splice kit manufacturer:
 - a. Rated a minimum of 25 kV when used for 5, 8, 15, and 25 kV cable.
 - b. 15.2 kV maximum phase-to-ground rating on 25 kV maximum rated splices.
 - c. 40 kV AC, 60-hertz, one minute withstand rating.
 - d. 78 kV DC 15 minute withstand rating.
 - e. 125 kV BIL and full wave crest rating.
 - f. 19 kV minimum corona voltage level.
 2. Provide modular splices with the following current ratings and characteristics in accordance with ANSI/IEEE Standard 386 for use with 25 kV or less rated cables:
 - a. The modular splices shall be rated for 600-amps continuous current.
 - b. The splices shall have a 1000-amp RMS, 24 hour overload rating.
 - c. The splices shall have a 40 kA RMS symmetrical withstand rating for 0.20 seconds (12 cycles) and a 27 kA RMS symmetrical rating for 4 seconds (240 cycles).
 3. Use cable adapters ordered as part of the modular splice kits that are intended by the splice kit manufacturer to be used with the cables being connected to the splice connector.
 4. Install the modular splices in accordance with the manufacturer's instructions.
 5. The modular splices shall not be high potential cable tested at voltages above the modular splice manufacturer's specifications for testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conduit is ready for cable installation.
- B. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION

- A. Thoroughly swab conduits to remove foreign material before pulling cables.

3.3 INSTALLATION

- A. Install cable and terminations in accordance with manufacturer's instructions and to ANSI/IEEE C2.
- B. Ground cable shield at each termination and splice with a shield adapter kit consisting of braided ground lead and a shrink tube cover.
- C. Pull cables using suitable water-based lubricants and cable pulling equipment. Do not exceed cable pulling tensions and bending radius recommended by manufacturer.
- D. Avoid abrasion and other damage to cables during installation.
- E. Medium voltage cables shall be continuous between junction boxes, pull boxes, manholes, or equipment terminal cabinets. No splices will be permitted in medium voltage cables except at junction boxes, pull boxes, manholes, or equipment terminal cabinets.
- F. Provide park stands in equipment adjacent to each load break cable termination if not supplied with the equipment.

3.4 FIELD QUALITY CONTROL - VERY LOW FREQUENCY (VLF) TESTING

- A. Field inspection and testing shall be performed under provisions of Section 26 05 00.
- B. Inspect exposed cable sections for physical damage. Verify that cable is connected according to drawings and that shield grounding, cable support, and terminations are properly installed.
- C. Contractor shall inform Architect/Engineer of testing schedule to be performed one week prior to commencing testing should they want to witness testing.
- D. Cable Testing: The Contractor shall verify this test procedure with the cable manufacturer, the cable termination manufacturers, and the cable splice manufacturers to receive their approval for conducting the following tests. The Contractor shall ensure that the maximum test voltage does not exceed the limits for terminations or splices specified in ANSI/IEEE48, IEEE 386, or the manufacturer's specifications. The medium voltage cable testing shall be performed in accordance with the IEEE Standard 400.2-2013 covering VLF cable testing and the International Electrical Testing Association (NETA) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, specifically the sections relevant to VLF medium voltage cable testing, plus the information contained in this specification. Performance of the test by the Contractor shall constitute acceptance has been received and approved.

1. Perform VLF "acceptance" withstand testing and VLF-TD "tangent delta" power dissipation factor tests on each new medium voltage shielded cable segment after all splice connectors and cable termination stress cones have been completed, but with the cables disconnected from circuit breakers, switches, junction boxes, and equipment. Apply test potential between each conductor and its grounded insulation shield, with the other two circuit conductors and shields grounded. On armored cable, ground the armor and interstice conductors during tests on interlocked armor cable.
2. The VLF "acceptance test voltage" shall be per IEEE Standard 400.2-2013 or the latest version, Table-3, relative to testing with a sinusoidal wave form at 0.1 hertz. Acceptance testing time shall be for 60 minutes on new cable, but if the cable test is stable for at least 15 minutes and no failures occur, the withstand test may be for just 30 minutes. Check cable, termination kits, and splice kit manufacturer's recommended test voltages and never exceed cable manufacturer's recommended test voltages:
 - a. VLF withstanding test voltages for sinusoidal waveforms; refer to IEEE 400.2.

Cable System Rating KV	Installation (phase to ground)		Acceptance (phase to ground)		Maintenance (phase to ground)	
	KV (rms)	KV peak	KV (rms)	KV peak	KV (rms)	KV peak
5	9	13	10	14	7	10
8	11	16	13	18	10	14
15	19	27	21	30	16	22

- b. VLF-TD, "tangent delta", dissipation factor" testing shall be done in accordance with IEEE Standard 400.2-2013, Section 5.4. The tangent delta shall be measured at $0.5U_0$, U_0 , and $1.5U_0$, where " U_0 " is the normal phase-to-ground operating voltage. The VLF-DTD, "differential tangent delta" shall be calculated, and the VLF-TDTS, "tangent delta temporal stability" shall also be calculated. All readings shall be recorded for the cable under test at the test voltages. Relative to new cable, per IEEE Standard 400.2-2013, Section 5.4.5, the diagnostic test results for the new cable should not be absolutely compared to the standard aged figures of merit for test results, but the cable data will be available for future comparison on any subsequent tests. Relative comparisons between phases should be able to be made. Significantly high dissipation factors associated with a phase in comparison to other phases could be cause for concern.
3. VLF Testing:
 - a. VLF testing shall be done with calibrated VLF cable test equipment.
 - b. The testing shall be done in full accordance with the test equipment manufacturer's instructions for proper and safe use of the equipment.
 - c. Test results shall be recorded for each cable / conductor tested, with the date and time of the test as part of the recorded information.
 - d. The test results shall be summarized in a test report, of which an electronic copy shall be submitted to Architect/Engineer. The report shall indicate whether the test result is satisfactory and the conductor should be accepted for service.

- e. The Contractor shall notify the Architect/Engineer upon failed test results and not acceptable for service. The failed cable shall be replaced under warranty at no additional cost to the Owner.
4. Cables shall pass the specified withstand tests without breakdown. When a subsequent test is required, it shall similarly withstand the test voltage specified by Architect/Engineer. Do not exceed the published test values recommended by the cable manufacturer, termination kit manufacturer, or cable splice kit manufacturer. The Electrical Contractor is responsible for verifying and documenting the written test value limits from the various component manufacturers.
 5. Obtain Architect/Engineer acceptance on cable test report(s) per submittal review process prior to energizing the cables.
- E. Test Report Format: An example VLF test report has been included as an example at the end of this section. The Contractor may submit a similar standard form that includes the same information.

TABLE OF MAXIMUM DC TEST VOLTAGES OF NEW CABLE					
Cable test voltages may need to be less due to cable termination device limitations or lower cable manufacturer specified limits.					
Rated Voltage Phase-to Phase KV	Conductor Size AWG or KCMIL	Nominal Insulation Thickness mils		Maximum DC Field Test Voltages, KV During/After Installation	
		100% Insulation Level	133% Insulation Level	100% Insulation Level	133% Insulation Level
5	8 Ó 1000	90	115	28	36
5	Above 1000	140	140	28	36
8	6 - 1000	115	140	36	44
8	Above 1000	175	175	36	44
15	2 - 1000	175	220	56	64
15	Above 1000	220	220	56	64

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment grounding system
- B. Bonding system
- C. Grounding electrode system

1.2 QUALITY ASSURANCE

- A. Comply with UL 467 Grounding and Bonding Equipment.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Ground rods.

1.5 SUMMARY

- A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".
- B. Material: Copper
- C. Equipment Grounding Conductors: Insulated. Refer to Section 26 05 53 for insulation color.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

F. GB; Grounding Bar:

1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4" x 2", length of technology or applicable room.

G. IBT; Intersystem Bonding Termination:

1. Copper bar, 1/4" x 2" x 24". Provide with wall mounting brackets, insulators and pre-tapped holes.
2. Manufacturers:
 - a. Harger GBI Series.
 - b. Erico EGB Series.

2.2 CONNECTOR PRODUCTS

- A. Connectors: Exothermic-welded type in kit form, and selected per manufacturer's written instructions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods Copper-clad steel
- B. Concrete-Encased Grounding Electrode (Ufer): Fabricate according to Electrical Code, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG or 20 feet of 1/2" steel reinforcing bar.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

- C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- D. Structural Steel Connection: Exothermic-welded connections to structural steel. Coordinate with structure to provide physical protection.
- E. Underground Connections: Exothermic-welded connections. Use for underground connections.
- F. Connections at back boxes, junction boxes, pull boxes, and equipment terminations: The equipment grounding conductor(s) associated with all circuits in the box shall be connected together and to the box using a suitable grounding screw. The removal of the respective receptacle, luminaire, or other device served by the box shall not interrupt the grounding continuity.
- G. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.2 INSTALLATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.
- C. Grounding electrode conductor (GEC) shall be protected from physical damage by rigid polyvinyl chloride conduit (PVC) in exposed locations.
- D. In raceways, use insulated equipment grounding conductors.
- E. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.
- F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, below access floors, and elsewhere as indicated, with bolted connections to form a continuous ground path.

3.3 EQUIPMENT GROUNDING SYSTEM

- A. Comply with Electrical Code, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by Electrical Code are indicated.
- B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.
- C. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

3.4 BONDING SYSTEM

- A. Equipment Circuits: Install a bonding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, dampers, and heaters. Bond conductor to each unit and to air duct. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps or copper conductor sized equal to the equipment grounding conductor.
- B. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
- C. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack conductor at terminal board.
- D. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bar.
- E. Equipment Ground Conductor Continuity: All spliced equipment grounding conductors in junction boxes, cabinets, and distribution equipment shall be connected together and bonded to the metal enclosure.

3.5 GROUNDING ELECTRODE SYSTEM

- A. Ground Ring (Counterpoise):
 - 1. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at average distances not more than 60 feet apart. Provide a grounding conductor, electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 2 AWG for ground ring and for tap to building steel. Bury conductor not less than 30 inches below grade, 24 inches from building foundation, and 18 inches outside of roof drip line.
- B. Supplementary Grounding Electrode: Use driven ground rod on exterior of building.

- C. Ground Rods: Install at least two rods spaced at least 20 feet from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- D. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters, filtering devices, and similar equipment. Connect to pipe with grounding clamp connectors.
- F. Natural Gas Service Piping: Bond to natural gas main service with grounding clamp connectors. Bonding conductor shall be connected to the main service ground bar. Provide grounding jumpers around all breaks in metallic continuity.
- G. Concrete-Encased Grounding Electrode (Ufer): Install concrete-encased grounding electrode encased in at least 2 inches of concrete horizontally within the foundation that is in contact with the earth. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
 - 1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.
 - 2. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
 - 3. Testing: Perform the following field quality-control testing:
 - a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

- b. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

3.7 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2. Maintain restored surfaces. Restore disturbed paving.

END OF SECTION

SECTION 26 05 27 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and Equipment Supports
- B. Fastening Hardware
- C. Concrete Housekeeping Pads
- D. Foundation and Underground Sleeves and Seals

1.2 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.3 COORDINATION

- A. Coordinate size, shape and location of concrete pads with section on Cast-in-Place Concrete or Concrete Topping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Allied Support Systems
- B. Cooper B-Line
- C. Erico, Inc.
- D. Hilti
- E. Power Fasteners
- F. Orbit Industries

2.2 MATERIAL

- A. Support Channel: Hot-dip galvanized; painted steel for interior/dry locations. All field cut ends shall be touched up with matching finish to inhibit rusting.
- B. Hardware: Corrosion resistant.

C. Anchorage and Structural Attachment Components:

1. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to Authorities Having Jurisdiction.
 - a. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
2. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
3. Beam clamps for Steel Beams and Joists: Double sided or concentric open web joist hangers. Single-sided type is not acceptable.
4. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.
5. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
6. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

2.3 FOUNDATION - UNDERGROUND SLEEVES AND SEALS

A. Wall Seals ("Link-Seals"):

1. Where shown on the drawings, raceways passing through foundation walls to an underground condition shall have their annular space (sleeve or drilled hole or not tapered hole made with knockout plug) sealed by properly sized sealing element consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve.
3. Sleeves shall be at least 2 trade sizes larger than the penetrating raceway.
4. Pressure shall be maintained by stainless steel bolts and accessories. Pressure plates may be of composite materials for Models S and OS.
5. Sealing Elements shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40°F to 250°F
T	Fire Seals (1 hour)	Silicone	-67°F to 400°F
FS	Fire Seals (3 hours)	Silicone	-67°F to 400°F
OS	Oil Resistant / Stainless	Nitrile	-40°F to 210°F

6. Approved Manufacturers:
 - a. Thunderline Corporation "Link-Seals"

- b. O-Z/Gedney Company
- c. Calpico, Inc
- d. Innerlynx

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.
- B. Trapeze support installation: Cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.
- E. Do not use powder-actuated anchors without specific permission.
- F. Do not drill structural steel members.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.
- I. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing in stud walls for rigid mounting. **Provide steel channel supports to stand cabinet one inch off wall.**
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- L. Refer to Section 26 05 33 for special conduit supporting requirements.

3.2 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
- B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

END OF SECTION

SECTION 26 05 33 - CONDUIT AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rigid metallic conduit and fittings (RMC)
- B. Electrical metallic tubing and fittings (EMT)
- C. Rigid polyvinyl chloride conduit and fittings (PVC)
- D. Wall and ceiling outlet boxes
- E. Electrical connection
- F. Pull and junction boxes
- G. Rough-ins
- H. Handholes
- I. Accessories

1.2 RELATED WORK

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
 - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
 - 3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
 - 4. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
- B. Federal Specifications (FS):
 - 1. A-A-50553A - Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
 - 2. A-A-55810 - Specification for Flexible Metal Conduit
- C. NECA "Standards of Installation"

- D. National Electrical Manufacturers Association (NEMA):
 - 1. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
 - 2. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
 - 3. TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation
- E. NFPA 70 - National Electrical Code (NEC)
- F. Underwriters Laboratories (UL): Applicable Listings
 - 1. UL 1 - Flexible Metal Conduit
 - 2. UL 6 - Rigid Metal Conduit
 - 3. UL 360 - Liquid Tight Flexible Steel Conduit
 - 4. UL514-B - Conduit Tubing and Cable Fittings
 - 5. UL651-B - Continuous Length HDPE Conduit
 - 6. UL746A - Standard for Polymeric Materials - Short Term Property Evaluations
 - 7. UL797 - Electrical Metal Tubing
- G. American Standard of Testing and Materials (ASTM):
 - 1. ASTM D 570 - Standard Test Method for Water Absorption of Plastics
 - 2. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics
 - 3. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edge Wise Position
 - 4. ASTM D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
 - 5. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
 - 6. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material
- H. Definitions:
 - 1. Fittings: Conduit connection or coupling.
 - 2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.
 - 3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
 - 4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
 - 5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.
7. Slab: Horizontal pour of concrete used for a floor or sub-floor.

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

A. Manufacturers:

1. Allied
2. LTV
3. Steelduct
4. Calbond Calpipe
5. Wheatland Tube Co
6. O-Z Gedney
7. or approved equal.

B. Manufacturers of RMC Conduit Fittings:

1. Appleton Electric
2. O-Z/Gedney Co.
3. Electroline
4. Raco
5. Bridgeport
6. Midwest
7. Regal
8. Thomas & Betts
9. Crouse-Hinds
10. Killark
11. Orbit Industries
12. or approved equal.

C. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.

D. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.
5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.
- B. Manufacturers of EMT Conduit:
 1. Allied
 2. Calbond Calpipe
 3. LTV
 4. Steelduct
 5. Wheatland Tube Co
 6. or approved equal.
- C. Fittings and Conduit Bodies:

2.3 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.
- B. Manufacturers:
 1. American Flex
 2. Alflex
 3. Electri-Flex Co
 4. or approved equal.
- C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.
- D. Fittings and Conduit Bodies:
 1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-in type, die-cast zinc.
 2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
 3. Manufacturers:
 - a. O-Z/Gedney Co.

- b. Thomas & Betts
- c. Appleton Electric
- d. Electroline
- e. Bridgeport
- f. Midwest
- g. Regal
- h. Orbit Industries
- i. or approved equal.

2.4 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

- A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.
- B. Acceptable Manufacturers:
 - 1. Carlon (Lamson & Sessions) Type 40
 - 2. Cantex, J.M. Mfg.
 - 3. or approved equal.
- C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.
- D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.
- E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

2.5 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, 16 gauge (approximately 0.0625 inches), with 1/2-inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.
- C. Cast Boxes: Nema FB1, Type FD, Aluminum, cast ferrous alloy, or stainless steel deep type, gasketed cover, threaded hubs.
- D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.

- E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.
- F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.
- G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.6 ECONN; ELECTRICAL CONNECTION

- A. Electrical connection to equipment and motors, sized per Electrical Code. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.7 JB; PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.
- E. Flanged type boxes shall be used where installed flush in wall.

2.8 ROUGH-IN

- A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate,
- B. Conduit stubbed to above the lay-in ceiling.

- C. RI-TECH; Technology Rough-in:
 - 1. Rough-in shall have one (1) 1" conduit.
- D. RI-TECH-W; Technology Rough-in - Wall Phone:
 - 1. Mount on wall +54" or as noted in plans. Rough-in shall have one (1) 1" conduit.
- E. RI-TECH-C; Technology Rough-in - Ceiling Flush Mounted:
 - 1. Mount flush in finished ceiling or as noted in plans. Rough-in shall have one (1) 1" conduit.
- F. RI-TV; Television Antenna Outlet Box Rough-in:
 - 1. Rough-in shall have one (1) 3/4" conduit.

2.9 HANDHOLES

- A. HH-1; Handhole, composite polymer concrete body and cover. Stainless steel hardware. Bolted non-skid cover rated for 5,000 pounds. Design load occasional non-deliberate vehicular traffic. Stack units to achieve depth shown on plans. Units in landscaped areas shall be green in color.
 - 1. Manufacturers:
 - a. Hubbell/Quazite PG####BB18, PG####HA00
 - b. Carson Industries H Series
 - c. Armorcast
 - d. Highline Products
 - e. Synertech

2.10 ACCESSORIES

- A. Fire Rated Moldable Pads: UL #9700, moldable sheet putty at required thickness on all five sides of back boxes. Kinetics Noise Control - IsoBacker Pad, SpecSeal - SSP Putty and Pads, 3M #MPP-4S or equal.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION SCHEDULE AND SIZING

- A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If this Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the Electrical Code shall be required.
- B. Installation Schedule: Refer to drawings.

- C. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to the Electrical Code. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the Electrical Code (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.
- D. Minimum Conduit Size (Unless Noted Otherwise):
 - 1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)
 - 2. Below Grade 5' or less from Building Foundation: 3/4 inch.
 - 3. Below Grade More than 5' from Building Foundation: 3/4 inch.
 - 4. Telecommunication Conduit: 1 inch.
 - 5. Controls Conduit: 1/2 inch.
- E. Conduit Embedded in Slabs above Grade:
- F. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.2 CONDUIT ARRANGEMENT

- A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.
- B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.
- C. Conduit arrangement in elevated slabs (restricted to applications specifically noted or shown on drawings):
 - 1. Conduit size shall not exceed one-third of the structural slab thickness. Place conduit between the top and bottom reinforcing with a minimum of 3" concrete cover.
 - 2. Parallel conduits shall be spaced at least 8 inches apart. Exception: Within 18 inches of commonly served floor boxes, junction boxes, or similar floor devices. Arrange conduits parallel or perpendicular to building lines and walls.
- D. Conduit shall not share the same cell as structural reinforcement in masonry walls.

- E. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown diagrammatically shall be chosen by the Contractor based on information in the contract documents, in accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", in accordance with recognized industry standards, and coordinated with other contractors.
- F. Contractor shall adapt Contractor's work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.
- G. Contractor shall cooperate with all contractors on the project. Contractor shall obtain details of other contractor's work to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by Contractor. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

3.3 CONDUIT SUPPORT

- A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.
 - 1. Support wire used to independently support raceway and wiring systems above suspending ceilings shall be supported on both ends, minimum 12 gauge suspended ceiling support wire, and distinguishable from ceiling support systems by color (field paint), tagging, or equivalent means.
- B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.
- D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1-1/2" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.
- F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.

- G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the Electrical Code requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.
- J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.
- K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the Electrical Code requirements.
- L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.
- M. Finish:
 - 1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
 - 2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

3.4 CONDUIT INSTALLATION

- A. Conduit Connections:
 - 1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.
 - 2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.
 - 3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.
 - 4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.
- B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.

C. Conduit Bends:

1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.
2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).
3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.
4. Telecommunications conduits shall have no more than two (2) 90-degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.
 - a. A third bend is acceptable if:
 - 1) The total run is not longer than (33) feet.
 - 2) The conduit size is increased to the next trade size.
5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.
6. Telecommunications Conduit(s): Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.
7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.
8. Use conduit bodies to make sharp changes in direction (i.e. around beams).

D. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the Electrical Code.
2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.
3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.
4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5" below bottom of roof decking.
5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.

6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant. Seal penetrations with intumescent caulk, putty, or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of firewalls and floors shall be tested and certified as a system per ASTM E814 Standard for fire tests or through-penetration fire stops as manufactured by 3M or approved equal.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.
8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, identified for use with cable and raceway system, equal to O-Z/Gedney type EYD.
9. Horizontal conduit routing through slabs above grade
 - a. Conduits, if run in concrete structure, shall be in middle one-third of slab thickness, and leave at least 3" min. concrete cover. Conduits shall run parallel to each other and spaced at least 8" apart centerline to centerline. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Maximum conduit outside diameter 1".
 - b. No conduits are allowed in concrete on metal deck unless expressly approved in writing by the Structural Engineer.
 - c. No conduits are allowed to be routed horizontally through slabs above grade.
10. Do not route conduits across each other in slabs on grade.
11. Rigid polyvinyl chloride conduit (PVC) shall be installed when material surface temperatures and ambient temperature are greater than 40°F.
12. Where rigid polyvinyl chloride conduit (PVC) is used below grade, in a slab, below a slab, etc., a transition to rigid galvanized steel or PVC-coated steel conduit shall be installed before conduit exits earth. The metallic conduit shall extend a minimum of 6" into the surface concealing the non-metallic conduit.
13. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.
14. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.
15. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3" above finished floor (AFF).
16. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4" below ceiling and as close to the wall as possible.
17. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4" above finished floor (AFF) and as close to the wall as possible.

3.5 CONDUIT TERMINATIONS

- A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, Orbit Industries or approved equal.
- B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.
- C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.
- D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.
- E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the Electrical Code, shall be connected using flexible conduit rated for the environment. Flexible conduit shall not exceed 6' in length. Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.
- F. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer's recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.
- G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of all foreign matter prior to any wires or pull cords being installed.

3.6 UNDERGROUND CONDUIT INSTALLATION

- A. Conduit Connections:
 - 1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.
- B. Conduit Bends (Lateral):
 - 1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.
 - 2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2" and ten times the diameter for conduits over 2". Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with Architect/Engineer prior to conduit installation to determine bend radius.

C. Conduit Elbows (vertical):

1. Minimum metal or RTRC elbow radiuses shall be 30 inches for primary conduits (greater than 600V) and 18 inches for secondary conduits (less than 600V). Increase radius, as required, based on pulling tension calculation requirements.

D. Expansion Fittings at Finished Grade: Provide underground raceways with an expansion fitting after emerging from finished grade and exterior equipment pads. Field locate the expansion fitting above and within 24 inches of finished grade. Raceways extending less than 12 inches above finished grade, transitioning to LFMC within 12 inches of finished grade, and interior concrete building slabs do not require an expansion fitting unless required by code.

E. Conduit Placement:

1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.
2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.
3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum $f'c = 2500$ and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.
4. Before the Contractor pulls any cables into the conduit, Contractor shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.
5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.
6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.
7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.
8. All non-metallic conduit installed underground outside of a slab shall be rigid.

F. Horizontal Directional Drilling:

1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.
2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.

G. Raceway Seal:

1. Where a raceway enters a building or structure, it shall be sealed with a sealing bushing or duct seal to prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceway shall also be sealed.

2. All telecommunications conduits and innerducts, including those containing cables, shall be plugged at the building and vault with "JackMoon" or equivalent duct seal, capable of withstanding a 10-foot head of water (5 PSI).
3. Duct Seal Alternative Option: Inflatable duct seal system. Capable of withstanding a 10-foot head of water (5 PSEI).
 - a. Manufacturers:
 - 1) Raychem Rayflate Duct Sealing Systems RDSS
 - 2) Approved equal

3.7 BOX INSTALLATION SCHEDULE

- A. Galvanized steel boxes may be used in:
 1. Concealed interior locations above ceilings and in hollow studded partitions.
 2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8' above the highest platform level.
 3. Direct contact with concrete except slab on grade.
- B. Cast boxes shall be used in:
 1. Exterior locations.

3.8 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Recessed luminaires shall not be used as access to outlet, pull, and junction boxes. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.
- D. Locate and install to maintain headroom and to present a neat appearance.

3.9 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls.
 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.

2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.
- B. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.
 - C. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)
 - D. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.
 - E. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
 - F. Provide knockout closures for unused openings.
 - G. Support boxes independently of conduit.
 - H. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
 - I. Install boxes in walls without damaging wall insulation.
 - J. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.
 - K. Position outlets to locate luminaires as shown on reflected ceiling drawings.
 - L. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
 - M. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
 - N. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate conduit is used.

3.10 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Do not install boxes back-to-back in walls.
 - 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.
 - 2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.
- D. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

3.11 EXPOSED BOX INSTALLATION

- A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.
- B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.
- C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.
- D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.
- E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)
- F. Wood, plastic, or fiber plugs shall not be used for fastenings.
- G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION

SECTION 26 05 36 - CABLE TRAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cable trays
- B. Cable tray accessories

1.2 QUALITY ASSURANCE

- A. Electrical Code Compliance: Comply with Electrical Code as applicable to construction and installation of cable tray and cable channel systems.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)
- B. ASTM A123 - Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel
- C. ASTM A510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- D. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- E. NEMA VE 1 - Metallic Cable Tray Systems
- F. NEMA VE 2 - Cable Tray Installation
- G. IEC 61914 Cable Cleats for Electrical Installations

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 05 00.
- B. Indicate tray type, dimensions, support points, clamps, hangers, connectors, fittings, expansion joint assemblies, grounding connections, accessories and finishes.
- C. Submit manufacturer's installation instructions under provisions of Section 26 05 00.
- D. Include cable tray in composite electronic coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging.

- B. Store materials in a dry area indoors, protecting from damage and in accordance with manufacturer's instructions.

1.6 TESTING AND COMMISSIONING

- A. Visually inspect each cable tray ground connection for mechanical continuity.
- B. Visually inspect each structural suspension point for specified loading and spacing.
- C. Submit notification of testing and results under provisions of Section 26 05 00.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 26 05 00.
- B. Include cleaning and bolt-tightening procedures.
- C. Note grounding point on as-built drawings.

1.8 COORDINATION

- A. Coordinate layout and installation of cable trays and suspension system with other construction, including structural members, light fixtures, HVAC equipment, fire suppression systems, and partition assemblies.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all cable tray with all fittings and mounting hardware. Install according to NEMA class with 1.5 safety factor.
- B. Accessories and Fittings: Manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- C. Refer to manufacturers installation instructions and specific product data below for additional information.

2.2 WELDED WIRE MESH CABLE TRAYS

- A. CT-; Wire mesh type cable tray: 2" loading depth, 4" width. Provide trapeze support with plastic retainer.
 - 1. Manufacturers:
 - a. B-Line
 - b. Mono-Systems
 - c. Cope

- d. Cablofil Inc.
 - e. Hubbell HBT
-
- B. Tray: Continuous, rigid, welded steel wire mesh cable tray with continuous top wire safe edge with T-weld.
 - C. Wire mesh shall be welded at all intersections.
 - D. Material: Carbon steel wire, 0.197" minimum wire diameter, ASTM A510, Grade 1008. Wire shall be welded, formed and surface treated.
 - E. Finish: Finish shall be applied after welding and bending of mesh. Finish shall be electro-plated zinc galvanizing: ASTM B633, Type I, SC-1.
 - F. Provide UL listed grounding clip or clamp for continuous grounding of tray.
 - G. Accessories: Provide all supporting, hanging, tee, cross, level change, reducing, drop outs, expansion splice plates (thermal expansion/contraction) and miscellaneous hardware as required for a complete and functioning installation to manufacturer's recommendations.
 - H. Load Span Criteria: Install and support cable management system in accordance with span load criteria of L/240.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation: In conformance with NEMA VE 2 requirements and in accordance with manufacturer's instructions.
- B. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing between supports of **8** ft. maximum.
- C. Use expansion connectors where indicated in NEMA VE 1.
- D. Cut standard straight sections to length in field.
- E. Tray shall be electrically continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without support.
- F. Tray shall be field cut using the manufacturer's approved cutting device and methods. Cutting device shall be an offset blade bolt cutter. The use of standard bolt cutters is strictly prohibited.
- G. Bends in tray shall be accomplished by utilizing manufacturer's cutting guides.
- H. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.

- I. Provide bonding continuity between cable tray sections, fittings and conduit terminations in accordance with manufacturer's instructions.
- J. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- K. Remove burrs and sharp edges from cable trays.
- L. Seal penetrations through fire and smoke barriers.
- M. Install capped sleeves for future cables through firestop sealed cable tray penetrations of fire and smoke barriers as shown on drawings.
- N. Install cable trays with sufficient space to permit access for installing cables. Adjust mounting height only momentarily for field coordination with other trades and systems as required.
- O. Provide separation of cables of different systems, such as power, telecommunications, fire alarm system, security systems and audio or visual systems. Install barriers between power and low voltage cables.
- P. Provide seismic bracing of cable tray in accordance with UBC Chapter 16.

END OF SECTION

SECTION 26 05 48 - SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Seismic Requirements.

1.2 QUALITY ASSURANCE

A. General:

1. The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint and support system and perform seismic calculations in accordance with these specifications, state, and local codes.
2. Items used for seismic restraint of equipment and systems shall be specifically manufactured for seismic restraint.
3. These requirements are beyond those listed in Section 26 05 27 of these specifications. Where a conflict arises between the seismic requirements of this section and any other section, the Architect/Engineer shall be immediately notified for direction to proceed.

B. Manufacturer:

1. System Supports/Restraints: Company specializing in the manufacture of products specified in this Section.
2. Equipment: Each company providing equipment that must meet seismic requirements shall provide certification included in project submittals the equipment supplied for the project meets or exceeds the seismic requirements of the project.

- C. Testing Agency: An independent testing agency, acceptable to Authorities Having Jurisdiction, with experience and capability to conduct the testing indicated.

- D. Installer: Company specializing in performing the work of this Section.

1.3 REFERENCES

- A. International Building Code, 2015.
- B. ASCE 7-10, Chapter 13.

1.4 SUBMITTALS

A. Shop Drawings:

1. Calculations, restraint selections, and installation details shall be designed and sealed by a Structural Engineer licensed in the state where the project is located experienced in seismic restraint design and installation.

2. Coordination Drawings: Plans and sections drawn to scale, coordinating seismic bracing of electrical components with other systems and equipment in the vicinity, including other seismic restraints.
3. Manufacturer's Certifications: Structural Engineer licensed in the state where the project is located shall review and approve manufacturer's certifications of compliance.
4. System Supports/Restraints - Submit for each condition requiring seismic bracing:
 - a. Calculations for each seismic brace and detail utilized on the project.
 - b. Plan drawings showing locations and types of seismic braces on contractor fabrication/installation drawings.
 - c. Cross-reference between details and plan drawings to indicate exactly which brace is being installed at each location. Details provided are to clearly indicate attachments to structure, correctly representing the fastening requirements of bracing.
 - d. Clear indication of brace design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.
5. Equipment - Submit for each piece of equipment supplied:
 - a. Certification that the equipment supplied for the project meets or exceeds the seismic requirements specified. Equipment certification is to be provided by the manufacturer
 - b. Specific details of seismic design features of equipment and maximum seismic loads imparted to the structural support.
 - c. Engineering calculations and details for equipment anchorage and support structure.

B. A seismic restraint designer shall be provided whether or not exceptions listed in the applicable building code are met. If seismic restraints are not provided for a system that requires seismic bracing, the seismic designer shall submit a signed and sealed letter to the Architect/Engineer and Authorities Having Jurisdiction stating the exceptions, along with code reference, utilized for each item. Seismic designer shall review system installation for general conformance to the exception requirements stated in the code and document, in writing, the system has been installed in accordance to the exception.

1.5 TESTING AND INSPECTION

- A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the International Building Code.
- B. The Owner shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.
- C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.

- D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

1.7 DESIGN REQUIREMENTS

- A. This project is subject to the seismic bracing requirements of the International Building Code, **2015** edition.
- B. The following criteria are applicable to this project:
 1. Risk Category: II
 2. Seismic Importance Factor: $I_E = 1.0$
 3. Seismic Design Category: D
 4. Component Amplification Factors (a_p) and Component Response Modification Factors (R_p) shall be taken from Table 13.5-1 in ASCE 7-16 for the individual equipment or system being restrained.
 5. Component Importance Factors (I_p) shall be taken from Section 13.1.3 in ASCE 7-16 [CBC 2016] for the individual equipment or system being restrained.
 6. The total height of the structure and the height of the system to be restrained within the structure shall be determined in coordination with architectural plans and the General Contractor.
- C. Forces shall be calculated with the above requirements and Equation 13.3-1, -2, and -3 of ASCE 7-16, unless exempted by 13.1.4.
- D. Equipment shall meet International Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

1.8 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

1.9 WARRANTY

- A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

PART 2 - PRODUCTS

2.1 SUPPLIERS

- A. Following is a partial list of manufacturer/supplier contact information for seismic restraints:
 1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.
 2. Unistrut Corporation <http://www.unistrut.us/>
 3. Kinetics Noise Control (877) 457-2695, www.kineticsnoise.com.
 4. Mason Industries, Inc. www.mason-ind.com.
 5. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.
 6. Tolco (909) 737-5599, www.tolco.com
 7. ISAT 877.523.6060, www.isatsb.com
 8. Vibro-Acoustics (416) 291-7371, <https://virs.vibro-acoustics.com/>

2.2 SEISMIC DESIGN CRITERIA

- A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.
- B. Definitions:
 1. Stay in Place:
 - a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.

2.3 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
 1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.
 2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.
 3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.
 5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.

6. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

C. Housekeeping Pads:

1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

2.4 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.

B. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:

1. Switchboards, Distribution Panelboards, Panelboards, Load Centers
2. Disconnect Switches
3. Magnetic, Manual, Combination Starters
4. Interior Luminaires
5. Emergency Luminaires and Exit Signs

2.5 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.

2.6 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.7 SEISMIC BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch 2.7 mm thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
 - 1. Materials for Channel: ASTM A 1011, GR 33.
 - 2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.
 - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
 - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
 - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
 - 2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of conduit, equipment, etc.
- B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.
- C. All rigid floor mounted equipment shall have a resilient media between the equipment mounting hole and the anchor bolt in concrete.

- D. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- E. Installation of seismic restraints shall not cause any change in position of equipment lighting or conduits resulting in stresses or misalignment.
- F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
- G. Do not install any equipment or conduit that makes rigid connections with the building unless isolation is not specified.
- H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or conduit due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.
- I. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.
- K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment or conduit.
- L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.
- M. Do not install cables over sharp corners.
- N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.
- O. Provide reinforced clevis bolts when required.
- P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.
- Q. Post-Installed anchors shall be provided to meet seismic requirements.
- R. Vertical conduit risers flexibly supported to accommodate thermal motion and/or conduit vibration shall be guided to maintain conduit stability and provide horizontal seismic restraint.
- S. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.

- T. Conduit crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the conduit, equipment connections, or support connections. Conduit offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent conduit.
- U. Do not brace a system to two different structures such as a wall and a ceiling.
- V. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- W. Positively attach all roof-mounted equipment to roof curbs. Positively attach all roof curbs to building structure.
- X. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.

3.2 SEISMIC RESTRAINT EXCLUSIONS

- A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

END OF SECTION

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Adhesive Markings and Field Labels
- B. Nameplates and Signs
- C. Product Colors

1.2 REFERENCES

- A. NFPA 70E - National Electrical Safety Code
- B. NFPA 70 - National Electrical Code (NEC)
- C. ANSI A13.1 - Standard for Pipe Identification
- D. ANSI Z535.4 - Standard for Product Safety Signs and Labels

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
- B. Exposed Ceilings and Finished Spaces: The project includes exposed ceilings in finished spaces. The installation of colored raceways and labeling may not be aesthetically desirable in finished spaces. The contractor shall coordinate identification requirements in exposed ceilings of finished spaces with the A/E prior to installation and ordering of materials.
- C. Electrical System Color Chart: This Contractor shall furnish and install framed 8" x 12" charts of the color-coded identification scheme used for the electrical system in all electrical rooms and next to the main fire alarm panel.
- D. Install identification devices in accordance with manufacturer's written instruction and requirements of Electrical Code.

- E. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.
- F. Circuit Identification: Tag or label conductors as follows:
 - 1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
 - 2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.
 - 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- G. Apply Danger, Warning, Caution and instruction signs as follows:
 - 1. Install Danger, Warning, Caution or instruction signs where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 - 2. 'Danger' indicates a hazardous situation which, if not avoided, will result in death or serious injury. ANSI standard red background, white letters.
 - 3. 'Warning' indicates a hazardous situation which, if not avoided, could result in death or serious injury. ANSI standard orange background, black letters.
 - 4. 'Caution' indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. ANSI standard yellow background, black letters.
 - 5. Emergency Operating Signs: Install, where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- H. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.
- I. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- J. Install ARC FLASH WARNING signs on all power distribution equipment per Section 26 05 73.
- K. Install ARC FLASH WARNING signs on all switchboards, switchgear, distribution panels, branch panelboards, industrial control panels, and motor control centers.

1. Sample Label:

! WARNING
ARC FLASH AND SHOCK HAZARD
APPROPRIATE PPE REQUIRED
FAILURE TO COMPLY CAN RESULT IN DEATH OR INJURY

- L. REFER TO NFPA 70E Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 (150mm) to 8 (205mm) inches below grade. A single plastic line marker is permitted when the width of the common trench does not exceed 16 inches; provide a second plastic line marker to mark each edge of the trench when 16 inches of width is exceeded.

END OF SECTION

SECTION 26 05 73 - POWER SYSTEM STUDY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Low voltage distribution system power study.
- B. Short-circuit analysis and report.
- C. Coordination analysis and report.
- D. Arc-flash hazard analysis and report.

1.2 RELATED SECTIONS

- A. Section 26 05 00 - Basic Electrical Requirements
- B. Section 26 24 13 - Switchboards
- C. Section 26 24 16 - Panelboards

1.3 QUALITY ASSURANCE

- A. Analyses shall be performed by an agent authorized by the manufacturer of equipment specified in the related specification sections.

1.4 SUBMITTALS

- A. Documentation shall bear the seal/signature of the licensed Professional Engineer who performed the analysis.
- B. The input for the power system study shall be based on the contract documents, with estimated conductor lengths provided by the Electrical Contractor. IMEG will provide a preliminary Power Tools for Windows project file for information, if requested.
- C. Documentation of the analyses shall be submitted in a single bound electronic (PDF or equal) format and shall accompany the shop drawing submittals for equipment provided under the related work specification sections. The submittal of these related specification sections will not be reviewed without this documentation. Submit a sample arc-flash hazard label for Owner review and approval prior to printing.
- D. Power system study project model shall be submitted on electronic media for review and the Owner's operating and maintenance records.

1.5 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC)
- B. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations, latest version
- C. ANSI Z535.4 - Products Safety Signs and Labels

1.6 SCOPE

- A. Provide a power system study of the electrical system shown on the plans. The study shall include arc-fault analysis, coordination analysis and arc flash hazard analysis.
- B. Contractor is required to provide a fully coordinated system for the normal electrical system and all other locations indicated on the one line diagram. Contractor shall provide overcurrent protective devices with the appropriate models, frame sizes, trip units, etc. as required to provide a coordinated system.

PART 2 - PRODUCTS

2.1 POWER SYSTEM STUDY

- A. Power systems study shall be completed in Power Tools for Windows (PTW) version 9 or later version or pre-approved equivalent program.
- B. Power system studies including, but not limited to short-circuit analysis, selective coordination, and arc-flash analysis are inherently iterative in nature. The initial and subsequent analysis commonly requires engineering evaluation, equipment modification, setting adjustments, and revised analysis report. The power system analysis scope shall not be considered complete until all outstanding engineering, equipment and device setting solutions have been resolved and documented by a final report. The power system study vendor shall provide inclusive bid provisions for the initial, subsequent, final analysis and associated reports.

PART 3 - EXECUTION

3.1 SHORT-CIRCUIT ANALYSIS

- A. Provide a complete short-circuit analysis from the utility service to and including the entire building distribution as shown on the drawings.
- B. Analysis shall include the entire distribution system from the point of connection to the utility power source to the distribution panels and branch circuit panelboards.
- C. Short-circuit analysis documentation shall be made in one-line diagram form showing the magnitude and location of each calculated fault. Fault current calculations shall be made at the main bus of each switchboard, distribution panel, and branch circuit panel. A summary of the fault currents available shall also be submitted and made available to the AHJ if requested.

3.2 COORDINATION ANALYSIS

- A. Provide a complete selective coordination analysis comparing time/current curves of the protective devices to be installed to assure coordination between main and downstream devices. Overcurrent protection devices shall be coordinated based on the maximum available fault current results of the short-circuit analysis report.
- B. Provide trip settings for all adjustable trip over current protection devices including long time delay, long time pickup, short time delay, short time pickup, instantaneous and ground fault. Selectively coordinated branches shall be based on the selective coordination study results. Non-selective coordinated branches shall be based on the design trip ratings. Provide selective coordination between all ground fault trip settings.
- C. The analysis shall include primary protective device, secondary main switchboard/switchgear device(s), switchboard/switchgear branch feeder devices, generator breaker, distribution panel, panelboard main devices, and branch feeder devices.
- D. The analysis shall include all normal, overcurrent protection devices served by the same electrical bus .
- E. The coordination plots provided shall indicate graphically the coordination proposed for the system on full-size log forms and shall define the types of protective devices selected, together with proposed time dial and pickup settings required. The plots shall include titles, representative one-line diagrams, legend, complete parameters for transformer(s), and complete operating bands for circuit breaker trip devices, fuses, etc.
 - 1. The long-time region of the coordination plots shall designate the pickups required for the circuit breakers.
 - 2. The short-time region shall indicate the magnetizing in-rush and ASA-withstand-transformer parameter, the circuit breaker, short-time and instantaneous trip devices, fuse-manufacturing tolerance bands, significant symmetrical fault currents, etc.
 - 3. Molded case circuit breakers shall be separated from each other and the associated primary protective device by a 16% current margin for coordination and protection in the event of secondary line-to-line faults.
 - 4. The protective device characteristics or operating bands shall be suitably indicated to reflect the actual symmetrical fault currents sensed by the device.
 - 5. The drawings and specifications indicate the general requirements for motors, motor-starting equipment, and low-voltage equipment, but additional specific requirements of equipment furnished shall be determined in accordance with the results of the coordination study.
 - a. The study shall include verification of equipment ratings and settings. The Contractor shall keep the study up-to-date with any project changes which affect the study and submit the revised study for review. A final electronic copy shall be submitted with the record drawings.
- F. Provide summary table of adjustable overcurrent protective devices settings for the operating and maintenance manual.

3.3 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E.
- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, unit substations, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.
- C. Safe working distances shall be based on the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit analysis and coordination study models. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- E. 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.
- F. 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 to 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).
- G. 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.
- H. When performing incident energy calculations on the line side of a main breaker (as required per the above), the line side and load side contributions must be included in the fault calculation.

- I. Miscoordination should be checked among 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.
- J. Where it is not physically possible to move outside 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.
- K. Create and install NFPA 70E compliant labels describing the arc flash hazard level at all switchboards, panelboards, and other locations in the electrical distribution system where work could be performed on energized parts.
- L. Labels shall be vinyl or laminated, with a self-adhesive backing, conform with ANSI Z535.4 Products Safety Signs and Labels standard, and include the following:
 - 1. Arc flash boundary
 - 2. Available incident energy calculated in the analysis and the corresponding working distance, or the arc flash personal protective equipment (PPE category) for the equipment, but not both.
- M. Examples showing the minimum required information follow:
- N. A list of all hazard categories and the corresponding PPE requirements shall be posted in the main electric room, engineering office, or other location. The list shall be plastic laminate or typewritten and housed in a plastic frame.

3.4 ADJUSTMENTS

- A. Manufacturer's authorized representative or Contractor shall set all adjustable protective devices to values indicated in the approved coordination study. Apply settings prior to placing equipment into operation. When the scope of work or execution includes remodel or phases construction, the contractor shall adjust applicable settings as required prior to each system component placed in operation.
- B. Wherever the arc flash incident energy exceeds Arc Flash Category 2 (i.e. greater than 8 cal/cm²), provide options for adjusting breaker trip times, if possible, to reduce energies to Category 2 or below.

3.5 TRAINING

- A. Provide four hours of Owner training to explain the implications of arc-flash requirements and work permit procedure.

END OF SECTION

SECTION 26 09 33 - LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Line and low voltage standalone lighting controls
- B. Time switches

1.2 RELATED SECTIONS

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
 - 1. 26 51 19 LED Lighting
 - 2. 26 52 15 Emergency Lighting Inverter
 - 3. Electrical Drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

1.3 RELATED WORK

- A. Section 01 91 00 - Commissioning
- B. Section 26 51 00 - Lighting

1.4 QUALITY ASSURANCE

- A. Manufacturers shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. All components and assemblies are to be factory pre-tested prior to delivery and installation.
- C. Comply with Electrical Code as applicable to electrical wiring work.
- D. Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

- E. Panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Panels and accessories used for control of life safety and critical branch circuits shall be listed under UL 924 Emergency Lighting and Power Equipment.
- F. All assemblies are to be in compliance with FCC emissions standards specified in Part 15 Subpart J for Class A applications.

1.5 REFERENCES

- A. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference
- B. FS W S 896 Switch, Toggle
- C. International Energy Conservation Code (IECC)
- D. NEMA WD 1 - General Color Requirements for Wiring Devices
- E. NEMA WD 7 - Occupancy Motion Sensors
- F. NFPA 70 - National Electrical Code (NEC)
- G. UL Standard 916 Energy Management Equipment
- H. UL 924 - Emergency Lighting and Power Equipment

1.6 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.
- B. Submit a comprehensive package including devices, hardware, software, product specification, finishes, dimensions, installation instructions, warranty, system software requirements.
- C. Provide floor plan showing location, orientation, and coverage area of each control device, sensor, and controller/interface. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer-approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.
- D. Submit a list of devices and equipment that will be installed for each sequence of operation.
- E. Submit project specific control wiring diagrams showing all equipment, line voltage, and control wiring requirements for all components including, but not limited to, dimmers, relays, low voltage switches, occupancy sensors, control stations, and communication interfaces and programming instructions for each sequence of operation. Include network cable specification and end-of-line termination details, if required.
- F. Coordinate integration with mechanical and/or other trades.

1.7 EXTRA STOCK

- A. Provide extra stock under provisions of Section 26 05 00.
- B. Sensors, Controls, Power Supplies, and Relays: Five (5) percent of quantity installed. Minimum of two (2) of each configuration and type.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit project record documents under provisions of Section 26 05 00.
- B. Accurately record location of all controls and devices. Include description of switching sequences and circuiting arrangements.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit emergency, operation, and maintenance data under provisions of Section 26 05 00. Data shall also include the following:
 - 1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and system components. Recommended schedule for inspection and recalibration of sensors.
 - 2. Complete narrative describing intended operation and sequence for each control scenario and system component, updated to reflect all changes resulting from commissioning of systems. Narrative shall indicate recommended settings for devices where applicable.
 - 3. Replacement part numbers for all system components.
- B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.
- C. Submit software operating and maintenance manuals, program software backup on compact disc or compatible media with data files, device address list, and a printout of software application and graphic screens, where applicable.

1.10 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying lighting design documents describe the minimum material quality, required features, and operational requirements of the lighting control system (LCS). These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the performance required of the system, as presented in these documents, the Contractor and system manufacturer/vendor are solely responsible for determining all equipment, wiring, and programming required for a complete and operational system.
- B. Provide an integrated lighting controls system consisting of panels, power supplies, controllers, sensors, relays, switches, devices, wiring, etc. necessary to perform the Lighting Control Sequence of Operation as defined on the plans and specifications. Contractor is responsible for confirming that all components and luminaires interoperate as a single system.

1. Sequence of Operation: Describes the required operation and performance for lighting control in each space. Sequences of operation are indicated on the drawings.
 2. Drawings: The drawings include sequences of operation, locations of control interface devices, sensors, and control zones. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted with the shop drawings.
- C. The following control types and features are acceptable. Acceptable control locations are shown on the drawings.
1. Line Voltage Control: Control equipment consists of traditional line voltage wiring devices and equipment such as switches, dimmers and combination occupancy/vacancy sensor switches, etc.
 2. Distributed Control: Control equipment is in the space/zone being controlled; not reliant on centralized controllers.
 - a. All locations shall have the ability to be networked for remote control and monitoring, but network connections are not required.

1.11 COMMISSIONING

- A. The Contractor shall provide all services necessary for compliance with the IECC Section C408 Commissioning. The commissioning shall include, but not be limited to, a commissioning plan, preliminary commissioning report, construction documents, manuals, final commissioning report, and lighting system functional testing.

1.12 WARRANTY

- A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of commissioning.
- B. Occupancy, vacancy, daylight sensors and controls shall have a five (5) year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROLS

- A. All items of material having a similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the specifications. Lighting control switches, systems, and components shall be listed.
- B. Color of lighting controls and sensors shall match the receptacle wiring devices specified in the space.
- C. The functions described in the lighting sequence of operation shall dictate the actual lighting control device required to accomplish the functions described for the space.

2.2 DEVICE COLOR

- A. All switch, lighting controls, and coverplate colors shall be the same as wiring devices, unless indicated otherwise.

2.3 COVERPLATES

- A. All switches and lighting controls shall be complete with coverplates that match material and color of the wiring device coverplates in the space.
- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 26 05 53.
- D. Plate-securing screws shall be metal with head color matching the wall plate finish.

2.4 WALL SWITCHES

- A. Switch touch surfaces shall have an antimicrobial additive that suppresses the growth of harmful bacteria, mold, mildew, and fungi. Coverplate color shall match the switch color.

- 1. Manufacturers:

- a. Cooper 7621 CuVerro
- b. Leviton A5621

- 2. Install antimicrobial switches and cover plates in following departments:

- B. SW-1P; Single Pole Switch:

- 1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.
- 2. Manufacturers:

- a. Hubbell HBL1221
- b. Leviton 1221-2
- c. Pass & Seymour PS20AC1
- d. Cooper AH1221

- C. SW-3W; Three-way Switch:

- 1. 120/277 volt, 20 amp. Toggle handle, side and back wired.
- 2. Manufacturers:

- a. Hubbell 1223
- b. Leviton 1223-2
- c. Pass & Seymour PS20AC3
- d. Cooper AH1223

2.5 WALL DIMMERS

- A. UL listed with integral air-gap switch for on/off control.
- B. Integral EMI/RFI suppression.
- C. Non-viewable heat sink.
- D. Dimmer compatibility and wiring with the load being controlled shall be verified by Contractor prior to purchase and installation.
- E. Dimmer to match device color.
- F. SW-OD; Wall 0-10V Dimmer / Occupancy sensor:
 - 1. Wall switch with manual on/auto off. 120VAC load rating of 0-800 W for electronic ballast, LED. 277VAC load rating of 0-1,800 W for electronic ballast, LED. adjustable OFF delay. 0-10V dimming with up to 30ma sink. Automatic ON/OFF, manual ON/automatic OFF, or occupancy on to predetermined dimming level go to last dimming setting upon occupancy.
 - 2. Manufacturers:
 - a. Sensor Switch WSX D Series

2.6 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.
 - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied, with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Vacancy sensors require a manual switch operation to turn lights on and off, with a time delay for turning lights off when unoccupied.
 - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 3. Relay Unit: Dry contacts rated for 20 A ballast load at 120 and 277 VAC, for 13-amp tungsten at 120 VAC, and for 1 hp at 120 VAC. Power supply to sensor shall be 24 V dc, 150-mA, Class 2 power source as defined by Electrical Code.
 - 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above accessible ceiling near entry door to room or area.
 - c. Time Delay and Sensitivity Adjustments: Recessed and concealed.
 - 5. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.
 - 6. Bypass Switch: Override the on function in case of sensor failure.

7. Power Supply and Child Packs: Provide as required for sensor quantity and switching scheme. Mount to standard 1/2" knockout on electrical box above accessible ceiling near entry door to room or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.
 8. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.
 9. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.
 10. Warranty: Five (5) year warranty.
- B. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.
1. SW-VS-D or SW-OC-D; 360 Degree Coverage Pattern:
 - a. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to activate), either technology maintains on status. Integrated ambient light level sensor (2 to 200 FC range), adjustable sensitivity and time delay, integrated isolated relay contact. Sensor shall control all circuits in area, unless noted otherwise. Initial settings: ambient sensor 40 FC.
 - b. Manufacturers:
 - 1) Watt Stopper DT 300 Series
 - 2) Hubbell OMNI-DT2000 or ATD2000C
 - 3) Greengate OAC-DT
 - 4) Leviton OSC##-MOW
 2. SW-O; Wall Switch:
 - a. Wall switch with manual on/auto off. 120/277 VAC load rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.
 - b. Manufacturers:
 - 1) Watt Stopper DW-100 Series
 - 2) Hubbell LHMTS, Leviton OSSMT series
- C. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.
1. SW-OC-P-HA; High Bay - Aisle Coverage Pattern:
 - a. 20' to 40' mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay. Sensor shall control all luminaires in area. Initial settings: Time delay 10 minutes.
 - b. Manufacturers:
 - 1) Watt Stopper HB-300 Series
 - 2) Hubbell FHB 140 or HMHB series

- 3) Leviton OSFHU
 - 4) Greengate OEF-P
2. SW-OC-P-HB; High Bay - 360 Degree Coverage Pattern:
- a. 20' to 40' mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay. Sensor shall control all luminaires in area.
 - b. Manufacturers:
 - 1) Watt Stopper HB-300 Series
 - 2) Hubbell FHB 140 or HMHB series
 - 3) Leviton OSFHU
 - 4) Greengate OEF-P
3. SW-O; Wall Switch Occupancy Sensor:
- a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (10 to 150 FC range), adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.
 - b. Manufacturers:
 - 1) Watt Stopper PW-100 Series
 - 2) Sensor Switch WSX
 - 3) Hubbell LHIRS1 or AP1277
 - 4) Leviton ODS15
 - 5) Greengate OSW-P-0451
4. SW-O2; Dual Wall Switch Occupancy Sensor:
- a. Passive infrared, zero crossing circuitry. Switches control two separate circuits or relays. Integrated ambient light sensor (10 to 150 FC range), adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.
 - b. Manufacturers:
 - 1) Watt Stopper PW-200 Series
 - 2) Sensor Switch WSX-2
 - 3) Hubbell LHIRD2 or AP127712
 - 4) Leviton ODS
 - 5) Greengate OSW-P-0451
5. SW-OC-P-P; Ceiling Mounted - 360 Degree Coverage Pattern:
- a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, . Sensor shall control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40 FC.

- b. Manufacturers:
 - 1) Watt Stopper CI Series
 - 2) Sensor Switch CM-9
 - 3) Hubbell Automation Omni-IR
 - 4) Leviton OSC Series
 - 5) Greengate OMR-P Series

- 6. SW-OC-P-P2; Ceiling Mounted - 100 Degree Coverage Pattern:
 - a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, . Sensor shall control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40 FC.
 - b. Manufacturers:
 - 1) Watt Stopper WPIR Series
 - 2) Sensor Switch CM-9
 - 3) Hubbell LOIRWV or ATD1600W

- 7. SW-OC-P-W; Wall Mounted - 100 Degree Coverage Pattern:
 - a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC range), adjustable sensitivity and time delay, . Sensor shall control all circuits in the area unless noted otherwise. Initial settings: Ambient sensor 40 FC.
 - b. Manufacturers:
 - 1) Watt Stopper WPIR Series
 - 2) Sensor Switch CM-9
 - 3) Hubbell LOIRWV or ATD1600W

- 8. With daylight filter and lens to afford coverage applicable to space to be controlled.

2.7 CONDUCTORS AND CABLES

A. Control Wiring:

- 1. Where installed with the line-voltage wiring, control wiring shall be copper conductors not smaller than No. 16 AWG with insulation voltage rating and temperature rating equal to that of the line-voltage wiring, complying with Division 26 Section 26 05 13 "Wire and Cable."
- 2. Tap conductors to switches or relays: Stranded copper conductors of 16 AWG or solid 16 or 18 AWG with insulation rating equal to that of the line-voltage wiring.
- 3. Tap conductors to dimming ballasts: Solid copper conductors of 18 AWG with insulation voltage rating equal to that of the line-voltage wiring and insulation temperature rating not less than 90°C.
- 4. Network cabling as required by manufacturer.

B. Splices and Taps:

1. Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-on, wire-nut type connectors are not allowed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings.
- B. All wiring shall be installed in conduit. Class II low voltage control wiring may be open wiring and shall maintain 150 mm (6 inch) spacing from electronic ballast and other RFI/EMI sources.
- C. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.

3.3 SUPPORT SERVICES

- A. Testing:
 1. System shall be completely functional tested by a factory-authorized technician. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system components.
 2. Programming of sensor settings shall be performed by a factory-authorized technician. Lighting Control Sequence of Operation shall serve as a basis for programming, . The following procedures shall be performed at a minimum:
 - a. Confirm occupancy sensor placement, sensitivity, and time delay settings to meet specified performance criteria.
 3. Verify occupancy/vacancy and daylight sensor operation is correct after furniture and equipment is installed in each area. Make adjustments to sensor settings and time delays to allow proper operation.

4. Verify occupancy/vacancy sensors are located to provide complete coverage for the area served with no nuisance switching.
 - a. Relocate sensors or provide additional sensors as necessary to provide adequate coverage.
 - b. Mask occupancy sensors where necessary to prevent nuisance switching from adjacent areas.

B. Training:

1. Manufacturer shall provide competent factory-authorized technician to train Owner personnel in the operation, maintenance and programming of the lighting control system. Submit training plan with notification seven (7) days prior to proposed training dates.
2. Training duration shall be no less than three (3) days, with one (1) day being scheduled at least two (2) weeks after initial training.

C. Documentation:

1. Manufacturer shall provide system documentation including:
 - a. System one-line showing all sensors.
 - b. Drawings for each panel showing hardware configuration and numbering.
 - c. Typical diagrams for each component.

3.4 SYSTEM COMMISSIONING

- A. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements. Refer to Section 01 09 00, General Commissioning, for further details.
- B. System verification testing is part of the commissioning process. Verification testing shall be performed by the Contractor and witnessed and documented by the Commissioning Agent. Refer to Section 01 09 00, General Commissioning, for system verification tests and commissioning requirements.
- C. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans. Refer to Section 01 09 00, General Commissioning, for Contractor training requirements.

END OF SECTION

SECTION 26 12 19 - PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Liquid-filled, Pad-Mounted Distribution Transformers TR-225

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in distribution transformers with three (3) years documented experience.

1.3 REFERENCES (Use the latest revision of referenced standards.)

- A. ANSI C57.12.70 - American National Standard Terminal Markings and Connections for Distribution and Power Transformers
- B. ASTM D877.02e1 - Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
- C. Department of Energy 10 CFR Part 431 - Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule.
- D. IEEE C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, & Regulating Transformers
- E. IEEE C57.12.28 - Standard for Pad-Mounted Equipment - Enclosure Integrity
- F. IEEE C57.12.34 - IEEE Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage & Below. (combines C57.12.22 and C57.12.26 of past.)
- G. IEEE C57.12.80 - IEEE Standard Terminology for Power and Distribution Transformers
- H. IEEE C57.12.90 - Standard Test Code for Liquid-Immersed Distribution Power, and Regulating Transformers
- I. IEEE C57.106 - Guide for Acceptance and Maintenance of Insulating Oil in Equipment
- J. IEEE C57.111 - Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers
- K. IEEE C57.121 - Guide for Acceptance and Maintenance of Less Flammable Hydrocarbon Fluid in Transformers

- L. NEMA 260 - Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas
- M. NEMA TR 1-1993 (R2000) - Transformers, Regulators and Reactors, Table 0-2 Audible Sound Levels for Liquid-Immersed Power Transformers.
- N. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association). Sections specific to transformers.
- O. Standards for Component Devices Related to Transformer Installation When Specified:
 - 1. ANSI C37.47 - American National Standard Specifications for Distribution Fuse Disconnecting Switches, Fuse Supports, and Current Limiting Fuses.
 - 2. ANSI/IEEE C37.41 - IEEE Standard Design Tests for High-Voltage (>1000 V) Fuses, Fuse and Disconnecting Cutouts, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Fuse Links and Accessories Used with These Devices
 - 3. IEEE 386 - Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.
 - 4. IEEE C37.40 - IEEE Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
 - 5. IEEE C37.48.1 - IEEE Guide for the Operation, Classification, Application and Coordination of Current Limiting Fuses with Rated Voltages 1 - 38 kV
 - 6. IEEE C57.13 - Standard Requirements for Instrument Transformers
 - 7. UL 489 - Molded Case Circuit Breakers

1.4 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 26 05 00.
- B. Shop drawings shall indicate electrical characteristics and field connection details, outline dimensions, connection and support points, weight, specified ratings and materials.
- C. All transformer nameplate information shall be supplied on the submittal drawings. The transformer impedance information shall be part of the submittal information.
- D. Where transformers are being supplied with integral fuses all details as to fuse make, fuse model, fuse ampere rating, and fuse time current curves applicable to transformer high voltage shall be supplied.
- E. Submit manufacturer's installation instructions under provisions of Section 26 05 00.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Section 26 05 00.
- B. Protect transformers in storage from moisture by using appropriate heaters if instructed by the manufacturer.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 26 05 00.
- B. Include procedures for cleaning unit, and replacing components.

PART 2 - PRODUCTS

2.1 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

A. Manufacturers:

- 1. Cooper Power Systems
- 2. General Electric
- 3. Howard Industries, Inc.
- 4. Schneider/Square D

B. Installation service conditions:

- 1. The transformer(s) shall be installed outdoors.
- 2. The transformer will be used within C57.12.00 usual service conditions as follows:
 - a. The cooling air ambient temperature shall not exceed 40°C (104°F), and the average temperature of the cooling air for any 24-hour period shall not exceed 30°C (86°F).
 - b. The top liquid temperature of the transformer, when it is operating, shall not be lower than minus 20°C (minus 4°F).
 - c. The altitude shall not exceed 1000 meters/3300 feet.

C. Description: Liquid-filled, pad-mounted, three-phase, two-winding transformers. Construction shall allow installation in locations accessible to the general public without the need for protective fencing or vaults.

D. The transformer shall be UL listed as follows:

- 1. The transformer shall have a UL Combination Listing/Classification Mark per UL XPLH. A Listing Mark combined with a Classification Mark shall be provided for transformers with less flammable liquid that have been additionally investigated by UL in accordance with Electrical Code Article 450. This combination shall include the following UL marking: "ALSO CLASSIFIED FOR USE AS LESS-FLAMMABLE LIQUID-INSULATED TRANSFORMER IN ACCORDANCE WITH ELECTRICAL CODE AND MARKED USE RESTRICTIONS ON THE TRANSFORMER."
- 2. The transformer shall have a UL Mark that the transformer is listed per UL XPLH. The Listing Mark shall include the UL symbol together with the word "LISTED", a UL control number, and the product name "Liquid-filled Distribution Transformer". The word "Transformer" may be abbreviated "XFMR", "XFRMR", or "XFORMER". This affirms that the transformer has been investigated by UL to UL-specified ANSI/IEEE standards stated in UL XPLH.

- E. The transformer electrical power frequency shall be 60 hertz.
- F. Transformer kVA shall be as specified on the project drawings. The transformers shall be self-cooled, and not have any forced cooling means, such as fans.
- G. The transformer coils shall be wound with aluminum conductors.
- H. The transformer primary/high voltage shall be as shown on the project drawings. The primary/high voltage winding configuration as delta or grounded-wye shall be as shown on the project drawings.
- I. The transformer high voltage basic lightning impulse level BIL shall be 60 kV.
- J. The transformer secondary/low voltage shall be as shown on the project drawings. The secondary/low voltage winding configuration as wye or delta shall be as shown on the project drawings. Where wye windings are specified, there shall be provisions for bonding the neutral terminal to ground at the transformer terminations.
- K. The transformer low voltage BIL shall be 30 kV.
- L. The transformer shall have a tap changer with the following full capacity, high voltage taps. The taps shall only be changed with the transformer de-energized. Provide an externally operable tap changer with tap position indicator and a means to padlock the tap changer at each position:
 - 1. Two 2.5% taps above nominal voltage and two, 2.5-percent taps below rated, nominal voltage.
- M. temperature at the transformer rating shall be as follows. The transformer shall be capable of being operated at rated load in a 30°C average ambient over 24 hours and a 40°C maximum ambient without loss of service life:
 - 1. 65°C rise above ambient.
 - 2. Transformers with low voltage less than 600 VAC:
 - a. 225 to 300 kVA: Impedance target shall be 4.00%. Manufacturer shall submit target impedance on submittal.
- N. The transformer dielectric, liquid coolant shall be as follows:
 - 1. Less flammable, silicone-based transformer fluid: Provide a fluid that is UL listed as complying with Electrical Code, Article 450 requirements for a fire point of not less than 300°C.
- O. High Voltage Bushings and Terminals.
 - 1. High voltage bushings shall be installed in the high voltage compartment located on the front left of the transformer.
 - 2. The bushing style shall be:

3. For transformers with a low voltage of 600 volts or less, bushing supports shall be provided for transformers that have ten or more connection holes.
4. For transformers with a low voltage of 600 volts or less, the bushing configuration shall be capable of terminating the number of cables allowed by the number of bushing holes specified.

P. Surge Arresters: Provide for each phase, IEEE 386 style, dead front, elbow-type, metal-oxide-varistor (MOV) style surge arresters mounted on one of the loop feed bushing sets. The MOV IEEE 386 arrester ratings shall be per the following table.

High Voltage Line-to-Line	Arrester Max Continuous Operating Voltage in kV rms Delta Windings	Arrester Max Continuous Operating Voltage in kV rms GrdY Windings
4160 VAC	5.10 kV	2.55 kV
12470 VAC	15.30 kV	8.40 kV
13200 VAC	15.30 kV	8.40 kV
13800 VAC	15.30 kV	10.20 kV
22860 GRDY VAC	NA	15.30 kV
24940 GRDY VAC	NA	17 kV
34500 GRDY VAC	NA	24.40 kV

Q. Transformer Tank and Cabinet Enclosure:

1. The high voltage and low voltage compartments shall be located side-by-side on one side of the transformer tank. The compartments shall be separated by a metal barrier. The access door to the high voltage compartment shall be provided whereby the high voltage compartment door can only be opened after the door to the low voltage compartment has been opened. There shall be one or more fastening devices that must be removed before the high voltage compartment door can be opened. The low voltage compartment door shall have, as a minimum, a three-point latching system with a handle with provisions for a pad lock. Door hardware shall be made of corrosion resistant material.
2. A recessed, captive, penta-head or hex-head bolt that meets the requirements of C57.12.28 shall secure all access doors. The transformer shall meet all tamper resistance requirements of C57.12.28.
3. The tank base shall be designed to allow skidding or rolling in any direction. Lifting lugs shall be provided on the tank to allow the transformer to be lifted from above. Jacking provisions shall be provided.

4. The transformer shall be of a sealed tank construction. The tank shall be able to withstand a pressure of 7 psi without any permanent deformation and a pressure of 15 psi without rupture.
 5. The tank cover shall be welded and the transformer tank hand hole fastenings shall be tamper resistant.
 6. The tank shall include a 15 psig pressure relief valve. The pressure relief valve capacity flow rate at 15 psig shall comply with UL listing requirements and, in no case, shall be less than 35 SCFM. The pressure relief device shall be self-sealing with an indicator.
 7. The transformer exterior shall be painted olive-green color Munsell 7GY3.29/1.5. The interior of the transformer cabinets shall be painted for corrosion resistance. The cabinet interior shall be painted a light color for ease of viewing. The tank coating/painting shall meet all requirements of ANSI C57.12.28, including salt spray, cross hatch adhesion, humidity, impact, oil resistance, ultraviolet accelerated weathering, and abrasion resistance.
- R. Accessories: The following accessories shall be provided on the pad-mounted liquid-filled transformers.
1. Nameplate in the low voltage compartment.
 2. 1-inch upper fill plug.
 3. 1-inch drain/sampling valve in low voltage compartment.
 4. Dial-type thermometer gauge.
 5. Liquid-level gauge.
 6. Pressure-vacuum gauge.
 7. Cover mounted, pressure relief device. Device shall be self-sealing with an indicator.
- S. Transformer Sound Level: The transformer sound level, as measured by the NEMA audible sound-level test procedure, shall be less than the values specified in NEMA TR 1 for liquid-filled transformers.
- T. Factory Standard Tests: The transformer shall be factory tested in accordance with IEEE C57.12.90. Tests include:
1. Ratio tests using all tap settings.
 2. Polarity and phase relation tests.
 3. No-Load losses tests.
 4. Load loss tests.
 5. Excitation current tests.
 6. Percent Impedance at rated current.
 7. Winding resistance measurement tests.
 8. Induced and applied potential tests.
 9. Full wave and reduced wave impulse test.
 10. Mechanical leak test.
- U. Certification of Transformer Tests: Provide certification of all design and other tests listed in C57.12.00, including verification that the design has passed short circuit criteria per IEEE C57.12.00 and C57.12.90.

2.2 IDENTIFICATION DEVICES (Project equipment tags)

- A. Equipment Tag Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section 26 05 53. (This is not the manufacturer's nameplate but the equipment tag for the specific use on the project.)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that the transformer foundation/pads are ready to receive work.
- B. Verify field dimensional measurements are as shown on the transformer shop drawings.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts conditions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install safety labels to NEMA 260.
- C. Install plumb and level.
- D. Install transformers, except for overhead pole type, on concrete bases.
 - 1. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at the Project, and requirements in Division 26 Section "Seismic Controls for Electrical Work".
 - 2. Construct concrete bases of dimensions indicated, but not less than inches larger in both directions than supported unit and 4 inches high.
 - 3. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete Cast-in-Place Concrete (Limited Applications)".
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 ADJUSTING

- A. Adjust primary/high voltage taps so that secondary voltage is within 2% of rated voltage at projected load. Verify the projected load with Architect/Engineer prior to final settings.

END OF SECTION

SECTION 26 13 14 - PAD MOUNTED MEDIUM VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED SECTIONS AND WORK

- A. Refer to the One-Line Diagram for additional information.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in medium voltage interrupter switches with five (5) years documented experience.

1.3 REFERENCES

- A. NFPA 70E - National Electrical Safety Code
- B. IEEE C37.74 - Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 KV
- C. IEEE C57.12.28 - Standard for Pad-Mounted Equipment Enclosure Integrity
- D. NFPA 70 - National Electrical Code (NEC)

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Accept the switchgear on site and inspect for damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. S&C Electric Company, Type PMH. Model shall be PMH-5
- B. Federal Pacific, Type PSI/II. The model shall be 5

2.2 SWITCHGEAR COMPONENTS

- A. Outdoor, pad-mounted switchgear consisting of compartments of 3-pole, non-fused, air-break, load-interrupter switches and compartments containing three, single-pole, fused, air-break load-interrupter switches, with all switches connected to a common bus structure within a single, self-supporting enclosure.

- B. The quantity and type of switches required in each compartment shall be as shown on the project one-line drawing(s). The 3-pole, non-fused switch compartment shall be connected to incoming power sources or shall be used to continue power source distribution loops. The compartments with three, single-pole, fused switches shall be used for power distribution to loads.
- C. The switchgear shall be manually operated.
- D. The switchgear shall be used at an operating system operating voltage of 12.47 kV, three-phase, 60-hertz.
- E. The switchgear main bus shall be aluminum.
- F. The three-pole, load-interrupter switch compartment ratings shall be as follows:
 - 1. Nominal voltage rating shall be a minimum of 14.4 kV.
 - 2. Maximum voltage rating shall be a minimum of 17.5 kV.
- G. Single-pole, fused switch compartment ratings shall be as follows:
 - 1. The fuse type shall be solid-material power fuses with an ampere rating value size (fuse E-size) as stated on the project drawings. The switch fuse mountings and fuses shall be:
 - a. S&C Electric SMU-20 fuse units with end fittings, including silencer rated 14.4 kV nominal and 17.0 kV maximum. The maximum fuse size shall be 200E. The single-pole switch with this fuse shall have a 14,000 amperes RMS symmetrical short circuit / fault closing rating.
 - 2. The single-gpole switch with fuses shall have a 200 amperes RMS symmetrical load interrupting / dropping capability.

2.3 ACCESSORIES

- A. Supply a switchgear hot stick fuse handling and single-pole switching tool (such as a Grappler) as recommended by the switchgear manufacturer with the switchgear. The tool shall be supplied with a universal pole / hot stick rated for the 14.4 kV or 25 kV switchgear for which it is being supplied.
- B. Supply the following maintenance devices with the switchgear:
 - 1. Shotgun style clamp stick for installation of grounding jumpers and for use with voltage testers. The shotgun style clamp stick provided shall be suitable for the voltage rating of the switchgear. Also supply a storage bag for the clamp stick.
 - 2. Supply a voltage tester with audio and visual signals with an adapter to work with the shotgun clamp stick. Supply a storage bag for the voltage tester. The tester supplied shall be suitable for the voltage rating of the switchgear.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Deliver to job site and install in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Distribution panelboards: DP-1, P-1
- B. Lighting and appliance branch circuit panelboards: Panel 'P1'

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Electrical Distribution Diagram and Electrical Schedules for size, rating, and configuration.

1.3 REFERENCES

- A. NEMA PB 1 - Panelboards
- B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- C. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment
- D. UL 67 - Panelboards

1.4 SUBMITTALS

- A. Submit shop drawings for equipment and component devices under provisions of Section 26 05 00.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Submit manufacturer's instructions under provisions of Section 26 05 00.

1.5 SPARE PARTS

- A. Keys: Furnish four (4) each to the Owner.
- B. Fuses: Furnish 10% or a minimum of three (3) spare fuses of each type and rating installed to the Owner.
- C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

PART 2 - PRODUCTS

2.1 RATINGS

- A. Definitions:
- B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

A. General

1. Manufacturers:

- a. Square D QMB, I-Line
- b. ABB ReliaGear Entelleon
- c. Siemens F2, P4
- d. Eaton PRL4, PRL5

- B. Panelboards: NEMA PB 1; type as shown on the drawings.
- C. Enclosure: NEMA PB 1; Type 1.
- D. Provide cabinet front with concealed trim clamps and hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Door hardware shall provide swing clear operation (180-degree swing). Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.
- F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.
- G. Minimum Integrated Short Circuit Rating: 100,000 amperes rms symmetrical for 240-volt panelboards; 50,000 amperes rms symmetrical for 480-volt panelboards, or as shown on the drawings.
- H. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

2.3 BRANCH CIRCUIT PANELBOARDS

A. General

1. Manufacturers:

- a. Square D NQ, NF
- b. ABB A Series
- c. Siemens P1
- d. Eaton PRL1, PRL2

- B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
- C. Enclosure: NEMA PB 1; Type 1.
- D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. Door hardware shall provide swing clear operation (180-degree swing). Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.
- F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.
- G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.
- H. Minimum Integrated Short Circuit Rating: As shown on the drawings.
- I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.
- J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

2.4 FUSIBLE BRANCH CIRCUIT PANELBOARDS

- A. Overcurrent protective devices shall be UL listed, with voltage, amperage, number of poles, and short-circuit current rating as shown on the panelboard schedule. Multi-pole branch circuit protection devices shall trip on an overcurrent of any pole to prevent single-phasing of the load.
- B. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future fuse units.
- C. All multiple-section panelboards shall have the same dimensional backbox and cabinet front size.
- D. Minimum Integrated Short Circuit Rating: As shown on the drawings.

2.5 ACCESSORIES

- A. Provide REQUIRED accessories as described below. Provide SCHEDULED accessories when listed with plan schedules. Refer to plan schedules for additional requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.
- B. Height: 6 feet to handle of highest device.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEIPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.
- E. Stub five (5) empty one-inch conduits to accessible location above ceiling out of each recessed panelboard.
- F. Install fuses in fusible switch assemblies.

3.2 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Device plates and box covers
- B. Receptacles (REC-#)
- C. Floor boxes and floor box with service fitting (FB-#)
- D. Cord and plug sets

1.2 QUALITY ASSURANCE

- A. Provide similar devices from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Electrical Code, by a testing agency to Authorities Having Jurisdiction and marked for intended use.

1.3 REFERENCES

- A. DSCC W-C-896F - General Specification for Electrical Power Connector
- B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
- C. NEMA WD 1 - General Color Requirements for Wiring Devices
- D. NEMA WD 6 - Wiring Devices - Dimensional Requirements
- E. NFPA 70 - National Electrical Code (NEC)
- F. UL 498 - Standard for Attachment Plugs and Receptacles
- G. UL 943 - Standard for Ground Fault Circuit Interrupters

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.
- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

1.5 COORDINATION

- A. Receptacles for Owner Furnished Equipment: Match plug configurations.
- B. Cord and Plug Sets: Match equipment requirements.
- C. Coordinate installation of receptacle assemblies in countertops and furniture with the Contractor providing the countertop or furniture. Contractor shall coordinate penetrations and conduit routing in countertops and furniture with drawings and other obstacles below the installation surface.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

- A. All switch, receptacle, and outlet colors shall be verified with Architect, unless indicated otherwise.

2.2 COVERPLATES

- A. All switches, receptacles, and outlets shall be complete with the following:
 - 1. Unbreakable thermoplastic/thermoset plastic and match device color coverplates in finished spaces where walls are finished.
- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 26 05 53.
- D. Plate securing screws shall be metal with head color matching the wall plate finish.

2.3 RECEPTACLES

- A. Refer to Electrical Symbols List for device type.
- B. Devices that are shaded on the drawings shall be red.
- C. REC-DUP: NEMA 5-20R Duplex Receptacle:
 - 1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap.
 - a. Manufacturers:
 - 1) Hubbell 5352A
 - 2) Leviton, 5362-S
 - 3) Pass & Seymour 5362

- 4) Cooper 5352

D. REC-DUP-GFI: NEMA 5-20R Ground Fault Duplex Receptacle:

1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, listed.
 - a. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
 - b. Manufacturers:
 - 1) Hubbell GF20L
 - 2) Leviton GFNT2
 - 3) Pass & Seymour 2097
 - 4) Cooper SGF20

E. REC-DUP-WP: NEMA 5-20R Weatherproof Ground Fault Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, weather resistant WR listed. Provide extra-duty NEMA 3R rated while-in-use cast aluminum cover.
2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
 - a. Manufacturers:
 - 1) Hubbell:
 - a) GFTWRST20 with aluminum housing WP826
 - b) GFCI type devices are not allowed. Contractor may substitute an alternative manufacturer when Hubbell is the basis of submittal for all other wiring devices.
 - 2) Leviton GFWT2 with aluminum housing M5979
 - 3) Pass & Seymour 2097TRWR with aluminum housing WIUCAST1
 - 4) Cooper WRS GF20 with aluminum housing WIUMV-1

F. REC-QUAD: NEMA 5-20R Double Duplex Receptacle:

1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.
 - a. Manufacturers:
 - 1) Refer to Duplex Receptacle above.
 - b. 120 Volt, 20 amp, NEMA 5-20R duplex receptacle.

2.4 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection, FS/UL listed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.
- B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.
- C. Ground Fault Protection: Provide ground fault protection for all branch circuit breakers serving 120/208 receptacles and electrical outlets rated 50 amps or less single-phase and 100 amps or less three-phase in the following locations, as shown on drawings, or required by adopted code:
 1. Bathrooms, locker rooms, shower rooms
 2. Kitchens' all 120-volt through 250-volt receptacles
 3. Buffet, serving, food preparation areas; all 120-volt through 250-volt receptacles
 4. Rooftops
 5. Interior/Exterior locations subject to damp/wet conditions
 6. When located within 6 feet of sinks, bathtubs, and shower stalls
 7. Plug-and-cord receptacles when the utilization appliance is located within 6 feet of a sink edge.
 8. Exterior dwelling outlets (disconnects, equipment connections, etc.) when required by code.
 9. Specific Appliances: Auto vacuum machines, water drink/bottle fill coolers, pressure staying machines, tire inflation machines, vending machines, sump pumps, dishwashers, electric ranges, ovens, clothes dryers, microwave ovens
 10. Future Provisions: Provide a conduit raceway and backbox for the future addition of countertop pop-receptacle when receptacles are not installed in kitchen islands and peninsulas.
- D. Tamper Resistant Protection: Provide tamper resistant protection for all 15 / 20-amp 120/208 straight blade wiring devices in the following locations, as shown on the drawings, or required by adopted code.
 1. Public Buildings: Corridors, waiting rooms, common areas
 2. Public Spaces involving: gymnasiums, fitness centers, auditoriums, public use venue common areas
- E. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.

- F. Install devices and wall plates flush and level.
- G. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 26 05 53 - Electrical Identification.
- H. Test receptacles for proper polarity, ground continuity and compliance with requirements.
- I. Floor Box Installation:
 - 1. Set boxes level and flush with finish flooring material.

END OF SECTION

SECTION 26 28 16 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches
- B. Non-fusible switches
- C. Motor disconnect switch

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Disconnect and Starter Schedule for rating and configuration.

1.3 REFERENCES

- A. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.
- B. Product Data: For each type of enclosed switch, circuit breakers, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.
- C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

- A. Acceptable Manufacturers:
 - 1. Square D 3110 Series

2. Eaton DH Series
 3. ABB TH Series
 4. Siemens HNF / HF Series
- B. FDS; Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.
- C. DS; Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position.
- D. Enclosures: Type as indicated on the disconnect schedule.
- E. Accessories: As indicated on the Disconnect Schedule. Provide the following accessories for each application.
1. Lockable
 2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.

2.2 MOTOR DISCONNECT SWITCH

- A. Listed UL 508 suitable for motor control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on the drawings.
- B. Install fuses in fusible disconnect switches.
- C. Field coordinate installation with other contractors and equipment to maintain code required working space requirements.
- D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

END OF SECTION

SECTION 26 29 23

VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes variable frequency controllers.
- B. Related Sections:
 - 1. Section 26 05 00 - Basic Electrical Requirements.
 - 2. Section 26 05 13 - Wire and Cable.
 - 3. Section 26 05 15 - Medium-Voltage Cable and Accessories.
 - 4. Section 26 05 26 - Grounding and Bonding.
 - 5. Section 26 05 27 - Supporting Devices.
 - 6. Section 26 05 33 - Conduit and Boxes.
 - 7. Section 26 05 36 - Cable Trays.
 - 8. Section 26 05 53 - Electrical Identification.
 - 9. Section 26 24 16 - Panelboards.
 - 10. Section 26 27 26 - Wiring Devices.
 - 11. Section 26 28 16 - Disconnect Switches.
 - 12. Section 33 32 19 - Sanitary Sewer Pumping Station.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
 - 4. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
 - 5. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches
 - 6. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 7. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers.
 - 8. NEMA ICS 3 - Industrial Control and Systems: Factory Built Assemblies.
 - 9. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 10. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01 33 00: Submittal procedures.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- C. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Field Reports: Indicate start-up inspection findings.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience and with service facilities within 100 miles of project. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- B. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- C. For the equipment specified herein, the manufacturer shall be ISO 9001 certified.
- D. AFD's shall be UL listed as a complete assembly. AFD's that require external fuses for the AFD to be UL listed are not acceptable. The AFD shall be UL listed for 100 KAIC without the need for input fuses.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for variable frequency controller.

1.9 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements Maintenance service.
- B. Furnish service and maintenance of variable frequency controller for one year from Date of Substantial Completion.

1.10 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each air filter.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY CONTROLLER

- A. Manufacturers:
 - 1. Cutler-Hammer
 - 2. ABB
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. The AFD shall be enclosed in a UL Listed Type 12 enclosure, completely assembled and tested by the manufacturer in an ISO 9001 facility. The AFD tolerated voltage window shall allow the AFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.
 - 1. Environmental operating conditions: 0 to 40°C continuous.
 - 2. Enclosure shall be rated UL type 12 and shall be UL listed as a plenum rated AFD.
- C. Ratings:
 - 1. Rated Input Voltage: 208 wye volts, three phase, 60 Hertz.
 - 2. Motor Nameplate Voltage: 208 wye volts, three phase, 60 Hertz.
 - 3. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

D. Design Features:

1. All AFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple AFDs.
2. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate “bumpless transfer” of speed reference when switching between “Hand” and “Auto” modes. There shall be fault reset and “Help” buttons on the keypad. The Help button shall include “on-line” assistance for programming and troubleshooting.
3. There shall be a built-in time clock in the AFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the AFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The AFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.
4. The AFD’s shall utilize pre-programmed application macro’s specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The AFD shall have two user macros to allow the end-user to create and save custom settings.
5. The AFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the AFD from the wall or removal of circuit boards. The AFD cooling fans shall operate only when required. To extend the fan and bearing operating life, operating temperature will be monitored and used to cycle the fans on and off as required. The AFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
6. The AFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
7. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
8. The AFD shall have an integral 5% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. AFD’s with only one DC reactor shall add AC line reactors.
9. The input current rating of the AFD shall be no more than 3% greater than the output current rating. AFD’s with higher input current ratings require the upstream wiring, protection devices and source transformers to be oversized per NEC 430-2.
10. The AFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV’s (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

11. The AFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false under-load condition.
 12. If the input reference (4-20mA or 2-10V) is lost, the AFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the AFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
 13. The AFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.
- E. All AFDs to have the following adjustments:
1. Three (3) programmable critical frequency lockout ranges to prevent the AFD from operating the load continuously at an unstable speed.
 2. Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the AFD, using the microprocessor in the AFD for the closed loop control. The AFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the AFD keypad, analog inputs, or over the communications bus. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (ie. valves, dampers, etc.). All setpoints, process variables, etc. to be accessible from the serial communication network. The setpoints shall be set in Engineering units and not require a percentage of the transducer input.
 3. Two (2) programmable analog inputs shall accept current or voltage signals.
 4. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
 5. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices, typically programmed as follows:
 6. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications) the AFD shall provide a dry contact closure that will signal the damper to open (AFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to an AFD digital input and allows AFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety status shall also be transmitted over the serial communications bus. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC.

7. Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. Default settings shall be for run, not faulted (fail safe), and run permissive. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable.
 8. Seven (7) programmable preset speeds.
 9. Two independently adjustable accel and decel ramps with 1 to 1800 seconds adjustable time ramps.
 10. The AFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.
 11. The AFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual AFD temperature that allows the highest carrier frequency without derating the AFD or operating at high carrier frequency only at low speeds.
 12. The AFD shall include password protection against parameter changes.
- F. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). The keypad shall utilize the following assistants:
1. Start-up assistants. Parameter assistants.
 2. Maintenance assistant.
 3. Troubleshooting assistant.
- G. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
 2. Motor Speed (RPM, %, or Engineering units)
 3. Motor Current
 4. Calculated Motor Torque
 5. Calculated Motor Power (kW)
 6. DC Bus Voltage
 7. Output Voltage
- H. The AFD shall include a fireman's override input. Upon receipt of a contact closure from the fireman's control station, the AFD shall operate at an adjustable preset speed. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands) and force the motor to run at the adjustable, preset speed. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the AFD shall resume normal operation.
- I. Serial Communications
1. The AFD shall have an RS-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Optional protocols for LonWorks, BACnet, Profibus, Ethernet, and DeviceNet shall be available. Each individual drive shall have the protocol in the base AFD. The use of third party gateways and multiplexers is not acceptable. All protocols

shall be “certified” by the governing authority. Use of non-certified protocols is not allowed.

2. The BACnet connection shall be an RS485, MSTP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
 - a. Data Sharing - Read Property - B.
 - b. Data Sharing - Write Property - B.
 - c. Device Management - Dynamic Device Binding (Who-Is; I-AM).
 - d. Device Management - Dynamic Object Binding (Who-Has; I-Have).
 - e. Device Management - Communication Control - B.

If additional hardware is required to obtain the BACnet interface, the AFD manufacturer shall supply one BACnet gateway per drive. Multiple AFDs sharing one gateway shall not be acceptable.

3. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the AFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote AFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus - keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the AFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.
4. The AFD shall allow the DDC to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any AFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analog inputs shall be capable of being monitored by the DDC system.
5. The AFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value control, etc. Both the AFD control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The AFD shall keep the last good set-point command and last good DO & AO commands in memory in the event the serial communications connection is lost.

- J. EMI / RFI filters. All AFD’s shall include EMI/RFI filters. The onboard filters shall allow the AFD assemble to be CE Marked and the AFD shall meet product standard EN 61800-3 for the First Environment restricted level.

- K. All AFD's through 50HP shall be protected from input and output power mis-wiring. The AFD shall sense this condition and display an alarm on the keypad.
- L. OPTIONAL FEATURES - Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.
1. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection shall be provided in both drive and bypass modes.
 2. Door interlocked, padlockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.
 3. Fused AFD only disconnect (service switch). Fast acting fuses exclusive to the AFD - fast acting fuses allow the AFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which have no such fuses, or that incorporate fuses common to both the AFD and the bypass will not be accepted. Three contactor bypass schemes are not acceptable.
 4. The drive / bypass shall provide single-phase motor protection in both the AFD and bypass modes.
 5. The following operators shall be provided:
 - a. Bypass Hand-Off-Auto
 - b. Drive mode selector
 - c. Bypass mode selector
 - d. Bypass fault reset
 6. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.
 - a. Power-on (Ready)
 - b. Run enable (safeties) open
 - c. Drive mode select damper opening
 - d. Bypass mode selected
 - e. Drive running
 - f. Bypass running
 - g. Drive fault
 - h. Bypass fault
 - i. Bypass H-O-A mode
 - j. Automatic transfer to bypass selected
 - k. Safety open
 - l. Damper opening
 - m. Damper end-switch made
 7. The following relay (form C) outputs from the bypass shall be provided:
 - a. System started
 - b. System running
 - c. Bypass override enabled
 - d. Drive fault
 - e. Bypass fault (motor overload or underload (broken belt))
 - f. Bypass H-O-A position
 8. The digital inputs for the system shall accept 24V or 115VAC (selectable). The bypass shall incorporate internally sourced power supply and not require an external control power source.
 9. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All

external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes (not functional in Fireman's Override 2). The remote start/stop contact shall operate in AFD and bypass modes.

10. Dedicated digital input that will transfer motor from AFD mode to bypass mode upon dry contact closure for fireman's override. Two modes of operation are required.
 - a. One mode forces the motor to bypass operation and overrides both the AFD and bypass H-O-A switches and forces the motor to operate across the line (test mode). The system will only respond to the digital inputs and motor protections.
 - b. The second fireman's override mode remains as above, but will also defeat the overload and single-phase protection for bypass and ignore all keypad and digital inputs to the system (run until destruction).
 11. The AFD shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided (local or remote start command in AFD or bypass mode). The AFD system (AFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch. When the AFD system safety interlock (fire detector, freezestat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.
 12. Class 20 or 30 (selectable) electronic motor overload protection shall be included.
 13. There shall be an internal switch to select manual or automatic bypass.
 14. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication (broken belt) when in the bypass mode
- M. All AFD's shall be sized per the load being served as indicated on the project drawings and specifications. Exact pump sizes will vary slightly from manufacturer to manufacturer. It shall be the responsibility of the Contractor to verify actual sizes of pumps provided and provide AFD's sized as required.

2.2 SOURCE QUALITY CONTROL

- A. Shop inspect and perform standard productions tests for each controller.
- B. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner and Architect/Engineer at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify building environment is maintained within service conditions required by manufacturer.

3.2 EXISTING WORK

- A. Disconnect and remove abandoned controllers.
- B. Clean and repair existing controllers to remain or to be reinstalled.

3.3 INSTALLATION

- A. Install in accordance with NEMA ICS 7.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Install fuses in fusible switches.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Install engraved plastic nameplates in accordance with Section 26 05 53.
- F. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- G. Ground and bond controller in accordance with Section 26 05 26.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements Manufacturer's field services.
- B. Prepare and startup variable frequency controller.
- C. Provide certified factory start-up for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive. Submit three copies of the certified start-up form to the A/E for distribution.

3.6 DEMONSTRATION AND TRAINING

- A. The Contractor shall provide a training session for up to five (5) owner's representatives for 1 normal workday at the jobsite or other office location chosen by the owner.
- B. A manufacturer's qualified representative shall conduct the training session.

- C. A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the AFD, bypass and serial communication.

3.7 WARRANTY

- A. The Adjustable Frequency Drives shall be warranted for 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel, time and expenses.

END OF SECTION

SECTION 26 51 19 - LED LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. Light-emitting diode (LED) luminaire systems
- C. Emergency exit signs

1.2 RELATED SECTIONS

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
 - 1. 26 09 33 Lighting Control Systems
 - 2. 26 52 15 Emergency Lighting Inverter
 - 3. Electrical drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

1.3 REFERENCES

- A. ANSI C78.377 - Specifications for the Chromaticity of Solid State Lighting Products
- B. ANSI C82.16 - Light-Emitting Diode Drivers - Method of Measurement
- C. ANSI C82.77 - Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment
- D. NFPA 70E - National Electrical Safety Code
- E. NEMA SSL1 - Electronic Drivers for LED Devices, Arrays or System
- F. UL 8750 - Light Emitting Diode (LED) Equipment for use in Lighting Products
- G. LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

- H. LM-80 - Measuring Luminous Flux and Color Maintenance of LED
- I. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary)
- J. UL 924 - Standard for Emergency Lighting and Power Equipment

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.
- B. Basic Requirements of Submittal:
 - 1. Submit product data sheets for luminaires, LED light engines, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with luminaires listed in ascending order, and with each luminaire's, LED light engine, driver, following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.
 - 2. Submit lens product data, dimensions and weights if not included in product data sheet submittal.
 - 3. Include outline drawings, support points, weights, and accessory information for each luminaire.
 - 4. Submit manufacturer origin of LED chipset and driver.
- C. LED Lighting - Performance Testing Submittal (when requested by Architect/Engineer):
 - 1. IESNA LM-79: Include photometric report for the latest generation system being furnished. Provide name of independent testing laboratory, report number, date of test, luminaire series/model number, input wattage, and light source specifications.
 - 2. IESNA LM-80: Measuring Lumen Maintenance of LED Light Sources.
- D. LED Lighting - Control Compatibility Submittal:
 - 1. Submit lighting control capability data for each LED luminaire. The submittal shall clearly identify device data proposed by the Contractor and approved by the luminaire manufacturer for dimming, switching, addressable, wireless, and similar control characteristics.

1.5 EXTRA STOCK

- A. Exit Signs: Provide 2 additional exit sign luminaires complete with labor, conduit, and wire. Additional exit luminaires shall be located per the Architect/Engineer or provided as attic stock when a location is not defined prior to Owner occupancy. When multiple exit signs are scheduled, the quantity listed above shall represent each type listed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site. Store and protect under provisions of Section 26 05 00.

- B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.

1.7 WARRANTY

- A. The warranty period begins at the date of Substantial Completion.
- B. LED Light Engines and Drivers:
 - 1. LED Drivers and Dimming Drivers: Five (5) years
 - 2. Light Emitting Diode (LED) Light Engines: Five (5) years

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Lensed Troffers: Provide hinged frames with latches and 0.125-inch thick virgin acrylic lenses. Prismatic lenses shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.
- B. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.
- C. Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction.
- D. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified. Verify suspension length prior to submittal.
- E. Painted reflector surfaces shall have a minimum reflectance of 90%.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Listed for wet or damp location as scheduled. Provide ingress protection (IP) rating when scheduled.
- B. Provide low temperature LED drivers, with reliable starting to -20°F.
- C. Exterior LED luminaires shall contain separate, easily accessible and replaceable Category C surge protection device.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

- A. Refer to the luminaire schedule for color temperature and minimum color rendering index CRI requirements. Provide light source color consistency by utilizing a binning tolerance within a maximum 3-step McAdam ellipse unless noted otherwise.

- B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.
- C. Rated life shall be minimum of 50,000 hours at L70.
- D. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.
- E. Luminaire delivered lumens is defined as the absolute lumens per the manufacturers LM-79-08 test report.
- F. LED luminaires shall be designed for ease of component replacement including modular replaceable boards or Zhaga sockets. Luminaires that are factory sealed and do not have field replaceable parts shall provide a 10-year warranty.
- G. LED light engine shall have a maximum LLD of 0.85 at 50,000 hours at 25°C ambient.
- H. LED Driver:
 - 1. Solid state driver with integral heat sink. Driver shall have over-heat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 10. Driver shall have a voltage fluctuation tolerance of +/- 10%.
 - 2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type. Dimming shall control light output in a continuous curve from 100% to 10% unless noted otherwise.
 - 3. Driver shall have a minimum of 50,000 hours rated life.
 - 4. Driver shall be tested to ANSI C82-16 for input current inrush, total harmonic distortion (THD), and power factor. Driver start time shall be less than 0.5 seconds to 98% of initial light output. Flicker should be less than 30% throughout the operating range.
 - 5. Driver shall be field replaceable without removal of the luminaire.
 - 6. Class A sound rating; inaudible in a 27 dBA ambient.
 - 7. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.

2.4 EMERGENCY EXIT SIGNS

- A. Exit Signs: Stencil face, 6-inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. The architectural ceiling framing system may be used in lieu of independent support with prior written approval by the ceiling system manufacturer and Authority Having Jurisdiction (AHJ). Luminaires and wiring installed in fire-rated ceiling assemblies shall be independently supported for all applications.
 - 1. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Provide independent support as follows:
 - a. Luminaires less than 56 lbs: Provide a minimum of two (2) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires.
 - b. Luminaires 56 lbs or greater: Provide a minimum of four (4) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires. Support luminaire independent of the ceiling system.
 - c. Luminaires larger than eight square feet (8 ft²): Support luminaire independent of the ceiling system.
- B. Do not fasten luminaire supports to piping, ductwork, mechanical equipment, or conduit, unless otherwise noted. Support wires shall be tightly wrapped (minimum of three turns within 3 inches of the connection) and sharply bend to prevent vertical movement.
- C. Support suspended or pendant mounted luminaires independent of ceiling grid with adjustable stainless steel aircraft cables or per luminaire schedule mounting requirements. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.
- D. Support wire used to independently support luminaires, raceways, and wiring systems shall be distinguishable from ceiling support systems by color (field paint), tagging or equivalent means.

3.2 CONSTRUCTION USE OF PROJECT LUMINAIRES

- A. The Contractor shall provide temporary construction lighting per the requirements of Division 1

3.3 RELAMPING

- A. Replace failed LED light engine modules or arrays at completion of work.

3.4 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. Touch up luminaire at completion of work.

3.5 OWNER TRAINING

- A. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to Substantial Completion, with the Owner's Representative.
- B. Provide electronic copy of periodic test log form to Owner's Representative. Explain and instruct Owner's Representative of requirements for testing and maintenance. Refer to latest adopted NFPA 101 for testing and logging requirements.

3.6 LUMINAIRE SCHEDULE

- A. As shown on the drawings.

END OF SECTION

SECTION 28 31 00 - FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 26 05 53 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.
- B. Section 28 05 37 - Distributed Antenna System (DAS) for Public Safety Networks.

1.2 REFERENCES

- A. ASME A17.1 - Safety Code for Elevators and Escalators
- B. NFPA 20 - Standard for Centrifugal Fire Pumps
- C. NFPA 70 - National Electrical Code (NEC)
- D. NFPA 72 - National Fire Alarm and Signaling Code
- E. NFPA 101 - Life Safety Code
- F. UL 2017 - General Purpose Signaling Devices and Systems
- G. UL 217 / 268 - Standard for Smoke Alarms / Smoke Detectors for Fire Alarm Systems
- H. UL 2572 - Control and Communication Units for Mass Notification Systems

1.3 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide quantity equal to 2 percent (2%) of amount of each type installed, but no less than two (2) units of each type.
 - a. Smoke and heat detectors, manual pull stations, duct smoke detectors, monitor modules, control modules and relays.
 - b. Notification Appliances: Speakers, speaker strobes, and strobes.
 - 2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or resettable device/cabinet minimum of one (1) set each and shall turn over to the Owner upon completion.
 - 3. All spare parts shall be housed in metal cabinet labeled "Fire Alarm Spare Parts."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Store and protect products under provisions of Section 26 05 00.

1.5 REGULATORY REQUIREMENTS

- A. System: UL or FM Global listed.
- B. Conform to requirements of NFPA 101.
- C. Conform to requirements of Americans with Disabilities Act (ADA).
- D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification Communications.

1.6 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.
- B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.
- C. Extending the Existing Fire Alarm System: Provide all items, components, devices, hardware, software, programming, expansion components, conduit, wiring etc. needed to extend fire alarm system. This includes, but is not limited to, additional power supplies, initiating devices and circuits, signaling devices and circuits, monitoring devices and circuits, auxiliary control and related devices such as, door holders and their control, smoke damper control, fan shutdown, etc. The existing fire alarm system shall be extended such that the existing fire alarm system's functionality, integrity and annunciation shall be equivalent to pre-construction conditions, unless noted otherwise. The functionality and integrity shall be maintained during construction. The entire system shall be able to be completely reset from any single reset location point. The entire system shall be annunciated at any annunciation location.

- D. Extending the Existing Fire Alarm System: The existing control panel shall remain and shall be operational throughout construction. The system shall only be disabled to make new connections and to modify the programming. A fire watch shall be provided for all areas affected during outages. All system outages must be scheduled with the Owner at least one week prior. Individual devices may be disabled as needed based on construction activities to reduce the potential for false alarms, but all devices must be operational when the Contractor is not physically on site. New initiating devices may be connected to the existing signaling line circuits where capacity is available. Provide additional signaling line circuits as needed based on existing and new device quantity, including replacement of existing panel components. Provide new notification circuits to serve the new devices, including all necessary power supplies, amplifiers, batteries, and 120-volt input circuits. All new devices shall be programmed to provide the same sequence of operation as the existing devices of the same type, unless noted otherwise.
- E. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.
- F. Campus Ethernet IP Network: A complete fire alarm and mass notification Ethernet network shall be provided. The network shall be Class X, Resilient Ethernet Protocol (REP) 100BaseTX / 100 Mbps that shall be able to operate with any single break and self-restoring network communications. Each building shall contain an independent building fire alarm / voice communications system, with full command and control from the campus command center. In no case shall read only network annunciation be acceptable as the only networking function.
- G. In-Building Network: A complete fire alarm system network shall be provided. Provide quantity of control panels as indicated on the drawings. The network shall be a Style 7 token ring, peer-to-peer network. The network shall be characterized by simultaneous or sequential transmission, or both, and reception of multiple signals on a signaling line circuit or communication channel. The distributed intelligent characteristic of the network shall provide for all nodes independently making pertinent system decisions with no need for a central controller. Each node shall be capable of independent operation should loss of network communications occur. In no case shall read-only network annunciation be acceptable as the only networking function.
- H. Voice Communication: The facility shall have an emergency voice alarm communication system. The digitized recorded voice message shall notify occupants that a fire condition has been reported. Emergency manual voice override shall be provided.
- I. Firefighter Phone System: A two-way talk path shall be provided for the fire department's use from the voice command center to the secondary fire alarm attack entrances, elevator lobbies, primary and backup power rooms and the entrance to all enclosed stairways.
- J. Emergency Communication System (ECS): A system capable of reproduction of prerecorded, synthesized, or live messages with voice intelligibility to indicate the existence of an emergency situation and communicating information necessary to facilitate an appropriate response and action. The system shall provide alerting in the building.

- K. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.
- L. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have cleared.
- M. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panels.
- N. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted on the shop drawings.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 26 05 00.
- B. Include location of end-of-line devices.
- C. Provide a CAD drawing of each area of the building (minimum scale of 1/16" = 1'-0") showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.
- D. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 26 05 00.
- B. Include operating instructions, and maintenance and repair procedures.
- C. Include results of testing of all devices and functions.
- D. Include manufacturer's representative's letter stating that system is operational.
- E. Include the CAD floor plan drawings.
- F. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

1.9 DOCUMENT STORAGE CABINET

- A. The cabinet shall have all fire alarm system documents, including record drawings, wiring diagrams, operation manuals, etc. A legend sheet permanently attached to the door shall contain system passwords and inspection logs. The enclosure shall also provide two (2) key ring holders for system keys and a location for a standard size business card with service contact information.
 - 1. The cabinet will have, permanently and securely mounted inside, a digital flash memory device with a minimum of 4 GB of storage capacity and a standard USB B connector for uploading and downloading electronic versions of record documents and system programming information.
- B. The cabinet shall be red in color with an identification label reading "FIRE ALARM DOCUMENTS". Refer to Identification Section 26 05 53. The cabinet shall be lockable. Minimum cabinet size shall be 14" x 14" x 48".
- C. The final version of the system database program shall be stored within the cabinet.
- D. Locate cabinet in the Mechanical Room.

1.10 WARRANTY

- A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.
- B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

1.11 ANNUAL INSPECTION/TESTING AND SERVICE CONTRACT

- A. Provide cost to furnish service, inspect, and test all devices of the fire alarm system per the requirement of NFPA for one (1) year, starting one year after the Date of Substantial Completion. Submit written reports of inspection testing per NFPA 72, Chapter 14.
- B. Provide an alternate cost for a complete inspection/testing and service/maintenance contract for the fire alarm system for one (1) year two (2) years, starting one year after the Date of Substantial Completion. Submit sample contract terms and conditions for review with shop drawings.
- C. The Owner may enter into a contract directly with the vendor after shop drawing submittals. This specification is not a contract between the Owner and the vendor to perform these services.

PART 2 - PRODUCTS

2.1 WIRING

- A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with the Electrical Code for power-limited fire alarm signal service.
- B. Fire Alarm Cable:
 - 1. Manufacturers:
 - a. Comtran Corp.
 - b. Helix/HiTemp Cables, Inc.
 - c. Rockbestos-Suprenant Cable Corp.
 - d. West Penn Wire/CDT.
 - e. Radix.

PART 3 - EXECUTION

3.1 SEQUENCES OF FIRE ALARM OPERATION

- A. General:
 - 1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system operation.
 - 2. The GUI/graphic annunciator shall display audible and visual alarms. The device activated shall be immediately displayed on a CAD floor plan at approximately 1/8" scale. Visual indication shall further indicate the device by utilizing an easily recognized color change of the symbol. The use of flashing symbols is encouraged.
 - 3. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
- B. Access Control Override Sequence:
 - 1. The fire alarm shall use addressable output relay(s) to signal the access control panel.
 - 2. Refer to the access control specifications for requirement upon fire alarm signal.

3.2 INSTALLATION

- A. Install system in accordance with manufacturer's instructions and referenced codes.

B. Devices:

1. General:

- a. All ceiling-mounted devices shall be located where shown on the reflected ceiling and floor plans. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern.
- b. All devices shall be coordinated with luminaires, diffusers, sprinkler heads, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacing shall not exceed the requirements of NFPA 72.
- c. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile.
- d. The location of all fire alarm devices shall be coordinated with other devices mounted in the proximity. Where a conflict arises with other items or with architectural elements that will not allow the device to be mounted at the location or height shown, the Contractor shall notify the Architect/Engineer to coordinate a different acceptable location.

2. Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.

3. Protection of Fire Alarm System:

- a. A smoke detector shall be installed within the vicinity of the main fire alarm panel and every NAC extender panel per NFPA 72. A heat detector may be substituted when a smoke detector is not appropriate for the environment of installation.

4. In-Duct Analog Smoke Detectors:

- a. In-duct analog smoke detectors shall be installed in the duct where shown on the drawings and details. The devices shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.
- b. All detectors shall be accessible.

5. Heat Detector, Linear Wire Type:

- a. Install detection wire within 20 inches of the underside of building roof, floor, or as recommended by the manufacturer.
- b. The protected area shall not exceed 4,000 square feet per zone. Provide a separate zone for areas divided by fire/smoke rated walls.

6. Manual Pull Stations:
 - a. Stations shall be located where shown and at the height noted on the drawings.
7. Addressable Relays and Monitor Modules:
 - a. Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings.
 - b. All modules shall be mounted in or on a junction box in an accessible location.
 - c. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.
8. SLC Loop Isolation Modules:
 - a. Isolation modules shall be installed to limit the number of addressable devices that are incapacitated by a circuit fault.
 - b. Install all Isolation Modules within the fire alarm control panel, unless otherwise indicated on the drawings. Refer to the fire alarm riser diagram for requirements. Refer to the floor plans for areas served by separate isolation modules.

C. Wiring:

1. Fire alarm wiring/cablings shall be provided by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes.
2. Wiring shall be installed in conduit.
3. Wiring shall be installed in conduit from device to above accessible ceilings. Exposed plenum-rated cable (FPLP) shall be used above accessible ceilings supported every 4 feet or run in cable trays (if applicable) maintaining a minimum of 5-inches clearance from all lighting ballasts. Fire alarm cabling shall not be installed in the same bridle rings or cable trays designated for the cabling of other systems.
4. All junction boxes with SLC and NAC circuits shall be identified on cover. Refer to Identification Section 26 05 13 for color and identification requirements.
5. Partial evacuation or relocation of occupants is the standard operating procedure for this facility in the event of an alarm. Therefore, all notification appliance circuits (NAC), including circuits serving NAC extender panels and other network communication circuits, must be installed and protected in accordance with the "circuit survivability" requirements described in NFPA 72. Contractor shall maintain the following:
 - a. NACs serving separate evacuation signaling zones shall be routed separately such that they are no less than 4 feet apart when run horizontally and 1 foot apart when run vertically. They may come simultaneously only within 10 feet of the control panel.
 - b. NACs passing through other evacuation signaling zone(s) shall be installed in conduit and routed through the 2-hour fire-rated chase(s) or enclosure(s) identified on the drawings.
 - c. NACs passing through other evacuation signaling zone(s) shall be Electrical Code classified CIC cable (Fire Alarm Circuit Integrity) installed in conduit. Provide CIC cable meeting UL requirements for 2-hour listing.

- 1) The CIC cable system shall be installed in a conduit system meeting all requirements of its UL-listed installation system (conduit, boxes, connectors, etc.).
6. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 26 05 13.
 7. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.
 - a. Fire alarm temporal audible notification for all audio appliances.
 - b. Synchronization of all visual devices where two or more devices are visible from the same location.
 - c. Ability to silence audible alarm while maintaining visual device operation.
 - d. Emergency communication alert and textual visible appliance notification.
 8. Notification Appliance Circuits shall not span floors or smoke compartments. Refer to architectural drawings for smoke compartments.
 9. Signal line circuits connecting devices shall not span floors or 2-hour smoke compartments.
 10. Signal line circuits connecting devices shall be provided with an isolation module at each floor separation or as otherwise shown on the drawings.
 11. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.
- D. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using colored tape at each conductor termination and in each junction box.
1. Power Branch Circuit Conductors: In accordance with Section 26 05 53.
 2. Signaling Line Circuit: Overall red jacket with black and red conductors.
 3. DC Power Supply Circuit: Overall red jacket with violet and brown conductors.
 4. Notification Appliance Circuit: Overall red jacket with blue and white conductors.
 5. Door Release Circuit: Gray conductors.
 6. Central Station Trip Circuit: Orange conductors.
 7. Central Station Fire Alarm Loop: Black and white conductors.
- E. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm equipment supplier. Backboxes shall be painted to match device, shall be the same shape and size as the device shall not have visible knockouts.

- F. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.

END OF SECTION

SECTION 31 05 13

SOILS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Subsoil materials.
 - 2. Topsoil materials.

- B. Related Sections:
 - 1. Section 31 05 16 - Aggregates.
 - 2. Section 31 22 13 - Rough Grading.
 - 3. Section 31 23 16 - Excavation and Fill.
 - 4. Section 31 23 17 - Trenching and Backfill.
 - 5. Section 31 25 13 - Erosion Control.
 - 6. Section 32 92 19 - Seeding.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

- C. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Samples: Submit, in air-tight containers, a 10 lb sample of each type of fill to the Architect/Engineer.

- C. Materials Source: Submit name of imported materials source.

1.4 QUALITY ASSURANCE

- A. Furnish each material from single source throughout the Work.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil: Conforming to IDOT Standard Specification Section 204.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 2 inches and debris.

2.2 TOPSOIL MATERIALS

- A. Topsoil: Conforming to IDOT Standard Specification Article 1081.05.
 - 1. Graded.
 - 2. Free of roots, rocks larger than 1/2-inch, subsoil, debris, large weeds and foreign matter.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services and analysis of soil material.
- B. Testing and Analysis of Subsoil Material: the Architect/Engineer shall perform in accordance with ASTM D698.
- C. Testing and Analysis of Topsoil Material: the Architect/Engineer shall perform in accordance with ASTM D698.
- D. When tests indicate materials do not meet specified requirements, change material and retest.
- E. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil and topsoil materials.
- C. Remove excess excavated subsoil and topsoil not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil and topsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site as designated by the Architect/Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Stockpile topsoil 8 feet high maximum.
- E. Prevent intermixing of soil types or contamination.
- F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- G. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 05 16

AGGREGATES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Coarse aggregate materials.
 - 2. Fine aggregate materials.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 32 13 13 - Concrete Paving.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- C. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Samples: Submit, in air-tight containers, a 25 lb. sample of each type of aggregate fill to the Architect/Engineer.
- C. Materials Source: Submit name of imported materials suppliers.

D. Manufacturer's Certificate: Certify aggregate suppliers are IDOT approved.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

A. All coarse aggregates used to complete the Work shall conform to IDOT Standard Specification Section 1004.

2.2 FINE AGGREGATE MATERIALS

A. All fine aggregate used to complete the Work shall conform to IDOT Standard Specification Section 1003.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing and inspection services.
- B. Testing and Analysis of Coarse Aggregate Material: the Architect/Engineer shall perform in accordance with ASTM D698.
- C. Testing and Analysis of Fine Aggregate Material: the Architect/Engineer shall perform in accordance with ASTM D698.
- D. When tests indicate materials do not meet specified requirements, change material and retest.

PART 3 EXECUTION

3.1 COARSE AGGREGATE

- A. Granular Subbase Material: CA-6 or CA-10; Place in accordance with IDOT Standard Specification Section 311.
- B. Aggregate Base: CA-6 or CA-10; Place in accordance with IDOT Standard Specification Section 351.
- C. Aggregate Surface: CA-6 or CA-10; Place in accordance with IDOT Standard Specification Section 402.

3.2 STOCKPILING

- A. If necessary, stockpile materials on site at locations indicated by the Architect/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.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removing surface debris.
 - 2. Removing designated pavement and appurtenances.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 23 16 - Excavation and Fill.
 - 3. Section 31 25 13 - Erosion Controls.

1.2 REFERENCES

- A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.
- B. Conform to USEPA and IEPA Standards and Specifications for Soil Erosion and Sediment Control.
- C. Conform to Local Codes and Ordinances for Disposal of Debris.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with IDOT Standard Specification Sections 201 and 440.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified.
- C. Identify area for placing removed materials.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 1-800-892-0123 not less than 48 hours before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

3.3 PROTECTION

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping.
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.
- D. Damage to any protected site appurtenances shall be replaced at the Contractor's expense.

3.4 CLEARING

- A. Site clearing shall not be conducted during heavy rains or excessively muddy soil conditions.

3.5 REMOVAL

- A. Remove debris, rock, and extracted plant life from site.
- B. Remove pavement and miscellaneous appurtenances as indicated on the Drawings.
- C. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- D. Do not burn or bury materials on site. Leave site in clean condition.

END OF SECTION

SECTION 31 22 13

ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cutting, grading, filling, rough contouring, and compacting site.
- B. Related Sections:
 - 1. Section 31 05 13 - Soils.
 - 2. Section 31 10 00 - Site Clearing.
 - 3. Section 31 23 16 - Excavation and Fill.
 - 4. Section 31 23 17 - Trenching and Backfill.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - 7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
 - 8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- C. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials suppliers.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with IDOT Standard Specification Sections 202 and 205.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 1-800-892-0123 not less than 48 hours before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Protect utilities indicated to remain from damage.
- D. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- E. Protect benchmarks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site to depth not exceeding 8 feet and protect from erosion.

D. Remove excess topsoil not intended for reuse, from site.

3.4 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.

B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

C. When excavating through roots, perform Work by hand and cut roots with sharp axe.

D. Remove excess subsoil not intended for reuse, from site.

E. Stockpile subsoil in area designated on site to depth not exceeding 8 feet and protect from erosion.

F. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key placed fill material to slope to provide firm bearing.

G. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 FILLING

A. Fill areas to contours and elevations with unfrozen materials.

B. Place fill material in continuous layers and compact. Refer to Specification Section 31 23 16 for additional compaction requirements.

C. Proof roll surface using pneumatic-tired equipment to expose unsuitably loose or soft subgrade.

D. Make grade changes gradual. Blend slope into level areas.

E. Repair or replace items indicated to remain damaged by excavation or filling.

3.6 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top Surface of Subgrade: Plus, or minus 0.1 feet.

END OF SECTION

SECTION 31 23 16

EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Stockpiling topsoil and reusable subsoil.
 - 2. Shoring and bracing for excavation.
 - 3. Fill for over-excavation.
 - 4. Backfilling site.

- B. Related Sections:
 - 1. Section 31 05 13 - Soils.
 - 2. Section 31 10 00 - Site Clearing.
 - 3. Section 31 22 13 - Rough Grading.
 - 4. Section 31 23 17 - Trenching and Backfill.
 - 5. Section 31 25 13 - Erosion Controls.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place of Nuclear Methods (Shallow Depth).
 - 7. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

- B. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

- C. Local utility standards when working within 24 inches of utility lines.

- D. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Samples: Submit, in airtight containers, a 10 lb. sample of each type of fill material to the Architect/Engineer.
- C. When recent test results are available for fill materials to be used, disregard samples submission and submit the test results to the testing laboratory. Test results shall clearly indicate material types, composition, hardness, compatibility and suitability for proposed usage.
- D. Proctors shall be obtained at least 7 days prior to placement of fills.
- E. Materials Source: Submit name of imported fill material suppliers.

PART 2 PRODUCTS

2.1 APPROVED FILL MATERIALS

- A. Angular pit run crushed natural stone: Free from shale, clay, friable materials and debris. Material shall be in accordance with IDOT Standard Specification Section 1004.
- B. CA-6 or CA-10 crushed stone: In accordance with IDOT Standard Specification Section 1004.
- C. Clean natural river or bank sand: Free from silt, clay, loam, friable or soluble materials and organic matter. Material shall be in accordance with IDOT Standard Specification Section 1003.
- D. Select site excavated subsoil material: Meeting the requirements of Specification Section 31 05 13. The use of topsoil as backfill is not allowed.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Call Local Utility Line Information service at 1-800-892-0123 not less than 48 hours before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Establish extent of excavation and fill areas by area and elevation. Designate and identify data elevation.
- D. Protect utilities indicated to remain from damage.

- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.2 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work.
- B. Excavate subsoil to accommodate construction operations.
- C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity.
- D. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- E. Notify Architect/Engineer of unexpected subsurface conditions.
- F. Correct areas over excavated as directed by Architect/Engineer.
- G. Remove excess and unsuitable material from site.
- H. Stockpile subsoil in area designated on site to depth not exceeding 8 feet and protect from erosion.
- I. Repair or replace items indicated to remain damaged by excavation.

3.3 EMBANKMENT

- A. Backfill areas to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Place fill material in continuous layers and compact.
 - 1. Subsoil fill shall be compacted to 95% Standard Proctor Density.
 - 2. Aggregate fill shall be compacted to 100% Standard Proctor Density.
- D. Employ placement method that does not disturb or damage other work.
- E. Maintain a maximum variation of 3% from Optimum Moisture Content of backfill materials to attain the required compaction density.
- F. Fill shall be placed in lifts not to exceed 6 inches in thickness.
- G. Make gradual grade changes. Blend slope into level areas.
- H. Remove surplus backfill materials from site.
- I. Leave fill material stockpile areas free of excess fill materials.

3.4 FIELD QUALITY CONTROL

- A. Request visual inspection of bearing surfaces by Architect/Engineer before installing subsequent work.
- B. Laboratory testing of materials will be performed by the Architect/Engineer in accordance with ASTM D698.
- C. Field compaction and moisture testing of materials will be performed by the Architect/Engineer in accordance with ASTM D6938.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.5 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.
- B. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

3.6 TOLERANCES

- A. Top surface of excavation or embankment: Plus, or minus 0.1 feet from required elevations.

3.7 SURPLUS MATERIALS

- A. Remove surplus materials from site.
- B. Leave stockpile areas completely free of all excess fill materials.

END OF SECTION

SECTION 31 23 17

TRENCHING AND BACKFILL

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavating trenches for utilities.
 - 2. Compacted fill from top of utility bedding to subgrade elevations.
 - 3. Backfilling and compaction.

- B. Related Sections:
 - 1. Section 31 05 13 - Soils.
 - 2. Section 31 05 16 - Aggregates.
 - 3. Section 31 22 13 - Rough Grading.
 - 4. Section 31 23 16 - Excavation and Fill.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 in.) Drop.

- B. ASTM International:
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 4. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

- C. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- C. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- D. Samples: Submit, in air-tight containers, 25 lb. sample of each type of fill to the Architect/Engineer.
- E. Materials Source: Submit name of imported fill materials suppliers.

1.5 QUALIFICATIONS

- A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Illinois.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.7 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: As specified in Section 31 05 13.
- B. Granular Fill: As specified in Section 31 05 16.

PART 3 EXECUTION

3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
 - 1. The Construction Manager reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 1-800-892-0123, not less than 48 hours before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

- A. Excavate subsoil required for utilities to utility service.
- B. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
- C. Do not advance open trench more than 40 feet ahead of installed pipe.
- D. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- E. Excavate bottom of trenches a maximum of 2 feet wider than outside diameter of pipe.
- F. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.
- G. Do not interfere with 45 degree bearing splay of foundations.
- H. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls can not be sloped, provide sheeting and shoring to protect excavation as specified in this section.
- I. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by the Construction Manager until suitable material is encountered.
- J. Cut out soft areas of subgrade not capable of proper compaction. Backfill with appropriate fill and compact to density equal to or greater than requirements for subsequent backfill material.

- K. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- L. Correct over-excavated areas with compacted backfill as specified for excavation or replace with concrete as directed by the Construction Manager.
- M. Remove excess subsoil, not intended for reuse, from site.
- N. Stockpile subsoil in designated areas on site to a depth not exceeding 8 feet and protect from erosion.

3.4 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. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.
- F. Sheeting, shoring and bracing activities shall be performed in accordance with applicable Occupational Safety and Health (OSHA) rules and regulations.

3.5 BEDDING

- A. Refer to Specification Section 31 05 16 for aggregates specified for use as bedding material.
- B. Bedding shall be in accordance with ASTM D2321. Bedding class shall be determined by the bedding material used.

3.6 BACKFILLING

- A. Granular backfill shall be used to backfill trenches under existing or proposed improved surfaces.
- B. Backfill trenches to contours and elevations with unfrozen fill materials.
- C. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- D. Place fill in continuous layers and compact.
 - 1. Compactive effort shall be applied to fine aggregate and subsoil fill to the satisfaction of the Construction Manager.

2. Coarse aggregate fill not located beneath footings or pavement shall be compacted to 95% Standard Proctor density.
- E. Maintain a maximum variation of 3% from optimum moisture content of backfill materials to attain the required compaction density.
- F. Place filter fabric prior to placing subsequent fill materials.
- G. Place fill material in continuous layers and compact.
- H. Employ placement method that does not disturb or damage foundation perimeter drainage and utilities in trench.
- I. Do not leave more than 40 feet of trench open at end of working day.
- J. Protect open trench to prevent danger to the public.

3.7 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.
- C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.8 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Laboratory testing of materials will be performed by the Architect/Engineer in accordance with ASTM D698.
- C. Field compaction and moisture testing of materials will be performed by the Architect/Engineer in accordance with ASTM D698.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.9 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 31 25 13

EROSION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Application of Temporary Seeding.
 - 2. Construction of Erosion Control Devices.
 - 3. Earthwork for Sideslope Stability.

- B. Related Sections:
 - 1. Section 31 05 13 - Soils.
 - 2. Section 31 10 00 - Site Clearing.
 - 3. Section 31 23 16 - Excavation and Fill.
 - 4. Section 32 92 19 - Seeding.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T88 - Standard Specification for Particle Size Analysis of Soils.
 - 2. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.

- B. American Concrete Institute:
 - 1. ACI 301 - Specifications for Structural Concrete.

- C. ASTM International:
 - 1. ASTM C127 - Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
 - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

- D. Precast/Prestressed Concrete Institute:
 - 1. PCI MNL-116S - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.

- E. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 SUBMITTALS

- A. Test Reports: Indicate certified tests results for precast concrete at manufacturing facility, cast-in-place concrete in field, and granular backfill.

1.4 SUMMARY OF REQUIREMENTS

A. All Construction Sites:

1. Construction activities must not cause a discharge that alters the physical, thermal, chemical, biological or radioactive properties of any waters of the State; or discharge a contaminant that is likely to cause a nuisance or be harmful to public health, wildlife, or other legitimate uses.
2. To the extent practicable, all construction sites must provide on-site methods to prevent sediment from entering the existing storm water system. Discharge of cloudy or sediment-laden water from any construction site to surface waters or any part of the sewer system is prohibited.
3. All construction sites must have stabilized construction site ingress and egress to limit tracking of sediment off-site. If site entrance becomes packed with mud, the Contractor shall clean or replace.
4. Construction sites must have vehicle wash locations where mud is removed by pressure washer prior to entering roadways. A cleaning program shall also be established for removal of mud, rock and debris from roadways.
5. A concrete washout area shall be provided that is adequately constructed to contain all wash water and spoils from entering storm water inlets and from seeping into the soil.
6. If sediment escapes the construction site, off-site accumulations of sediment must be removed by the end of the day.
7. Sediment must be removed from sediment traps or sedimentation basins when design capacity has been reduced by 50%.
8. Existing vegetation shall be preserved where possible to minimize erosion.

B. Construction Sites that Disturb One or More Acres:

1. Construction sites with a disturbed area of one or more acres must meet all applicable state and federal storm water discharge laws, regulations, and guidelines specified in this section. This includes construction sites less than 1 acre if part of a larger common development plan that is equal to or greater than 1 acre.
2. Required Documents:
 - a. Storm Water Pollution Plan: A Storm Water Pollution Prevention Plan (SWPPP) shall be prepared by the project Professional Services Consultant (PSC) to minimize the discharge of pollutants in storm water.
 - i. The SWPPP shall include all elements required by the Illinois Environmental Protection Agency (IEPA) NPDES Storm Water Permit ILR10, including, but not limited to an erosion and sedimentation control site map.
 - ii. The USEPA Summary Guidance document 833-R-92-001, entitled *Storm Water Management For Construction*

Activities: Developing Pollution Prevention Plans and Best Management Practices may also be used as a guide to developing the SWPPP.

- iii. Best management practices, controls, and other provisions contained in the SWPPP must be designed for a storm event equal to or greater than a 25-year 24-hour rainfall event and at least as protective as the requirements contained in the IEPA Illinois Urban Manual (1995 or most current edition).
- iv. The following items must be included in the SWPPP; however, this is not a comprehensive list:
 - 1. Dates for major grading activities, construction activities temporarily (less than 21 days) or permanently ceased on any portion of the site, site stabilization measures initiated, and SWPPP revisions.
 - 2. Description of how litter, construction debris, and construction chemicals exposed to storm water will be prevented from becoming a pollutant source for storm water discharges.
 - 3. Requirement for fuel storage tanks to have secondary containment to protect storm water from exposure to leaks and spills. The containment shall be designed to hold at least 110% of the volume of the largest stored container.
 - 4. Requirement that adequate amounts of spill containment and cleanup equipment are provided to prevent a spill (fuel or other chemical) from entering a waterway.
 - 5. Description of how off-site material storage areas (i.e. for soil/aggregate stockpiles, chemicals, paints, etc.) used solely by the project will be managed.
 - 6. Construction and maintenance areas for concrete and mortar washout if trucks or equipment will be cleaned on site.
- b. Notice of Permit Coverage: Prior to site disturbance, the Contractor must post a notice to the public of coverage under the Owner's IEPA General NPDES Permit No. ILR400523 For Discharges from Small Municipal Separate Storm Sewer Systems (MS4s). The notice must be placed in a location where the public can view it without entering the project site.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with IDOT Standard Specification Section 280.

1.6 SITE CONDITIONS

- A. Temporary erosion control during the active construction phases of the project shall be performed in accordance with the applicable portions of the Illinois

Department of Transportation Standard Specifications Section 280 and Highway Standard 280001. No straw or hay bales shall be used in the construction of temporary erosion control systems.

- B. All temporary erosion control methods ordered by the Construction Manager shall be coordinated with the permanent erosion control features specified elsewhere in the contract to the extent practical to assure economical, effective and continuous erosion control throughout the construction and post-construction period.
- C. All earth surfaces shall be seeded with temporary or permanent seeding immediately after completing grading operations.
- D. Underground utility facilities shall be clearly marked before final seeding operations begin.
- E. Heavy equipment shall not be operated within five feet of site improvements. Work required within these areas shall be by hand or with appropriate landscaping equipment.
- F. In the event of conflict between these requirements and pollution control laws, rules or regulations of other Federal or state or local agencies, the more restrictive laws, rules or regulations shall apply. The Contractor shall take sufficient precautions to prevent pollution of streams, lakes, and reservoirs with fuels, oils, bitumens, calcium chloride or other harmful materials.

PART 2 PRODUCTS

2.1 EROSION CONTROL MATERIALS

- A. Temporary Erosion Control Materials shall be in accordance with IDOT Standard Specification Section 280. No straw or hay bales may be used in the construction of temporary erosion control systems.

2.2 CONCRETE WASHOUT FACILITIES

- A. Temporary concrete washout facilities shall be placed as shown in the drawings or as directed by the Engineer. Washouts shall be located at least 50 feet from storm drain inlets, open drainage facilities or water bodies. Each facility is to be located away from construction traffic or access areas to prevent disturbance tracking.
 - 1. Construct facilities using a wood or aggregate perimeter to create a berm.
 - 2. Washout shall be lined with a minimum of one 10-mil polyethylene sheet free of holes, tears or other defects that may compromise the impermeability of the material.
 - 3. Sheeting must extend over the entire basin and perimeter berm to prevent escape of discharge.
 - 4. Signage shall be placed adjacent to each temporary washout facility to inform concrete equipment operators of the designated washout facility.

- B. The number and size of each washout facility is to be determined by the Contractor. It is the Contractor's responsibility to provide enough storage for the excess concrete and water produced on the project.
- C. Temporary concrete washout facilities shall be in place before delivery of concrete to the site commences.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.
- D. Verify gradients and elevations of base or foundation for other work are correct.

3.2 POSTING NOTICE OF PERMIT COVERAGE

- A. Notice of Permit Coverage shall be posted on site.

3.3 IMPLEMENTATION OF THE SWPPP

- A. The Contractor must implement the SWPPP prepared by the PSC and maintain all erosion and sedimentation measures specified in the SWPPP. If full implementation of the SWPPP does not provide effective erosion control, additional erosion and sediment control measures shall be implemented to control or treat the sediment source.
- B. The Contractor must provide a signed copy of the SWPPP to the Owner within 7 days of receiving a Notice to Proceed and may not begin any site disturbance until the following conditions are met:
 - 1. The Contractor reviews, approves, and certifies the SWPPP.
 - 2. The Owner reviews, approves and certifies the SWPPP.
 - 3. The Contractor begins SWPPP implementation (i.e. perimeter sedimentation controls, erosion control materials on-site, etc.).
- C. In the event that an inspection reveals a departure from the SWPPP requirements, the Contractor must remedy the deficiency within 7 calendar days.
- D. The PSC shall revise the SWPPP and erosion control site map as necessary within 7 calendar days following an inspection that indicates a change in or failure of design, construction, operation or maintenance that has a significant effect on the potential for pollutants to be discharged into storm sewers or surface water.
- E. The project SWPPP, all attachments and drawings and inspection reports shall be turned over to the Owner upon completion of the project.

3.4 REVISION OF THE SWPPP

- A. Should construction site activities/materials change during construction, the SWPPP must reflect the changes. The Construction Manager shall be notified

immediately if there is any proposed modification or revision to the SWPPP. Written authorization from the Owner may be required.

- B. If major changes are warranted, a revised plan must be submitted for review to the Construction Manager, who will then submit documents to the Owner and the IEPA for approval.

3.5 INSPECTION

- A. The PSC is responsible for conducting and documenting inspections of the construction site once every 7 calendar days AND within 24 hours after a rainfall event of 0.5 inch or greater or equivalent snowfall. At a minimum, the following areas must be inspected, if applicable, according to the above schedule:
 1. Disturbed areas.
 2. Waste and hazardous material storage areas.
 3. Construction material storage.
 4. Fuel and oil storage.
 5. Concrete wash-out stations.
 6. Locations where vehicles/equipment enter and exit the site.
 7. Structural sediment and erosion control measures (i.e. sedimentation basin, silt fence, inlet protection, seeding, etc.).
 8. Onsite and adjacent stormwater inlets.
 9. Adjacent streets, gutters and stockpiles.
- B. The Contractor shall use the IDOT SWPPP Erosion Control Inspection Report for reporting. The Contractor must retain completed inspection reports with the SWPPP on-site and make them available to the Construction Manager at all times.
- C. The Construction Manager will provide the PSC with an ION report form. Should the PSC observe any violations of the SWPPP, including those not required by the Plan, the PSC will complete and submit an ION report to the Construction Manager within 5 calendar days.
- D. The Construction Manager may conduct periodic site inspections of the work in progress to be certain that the drainage system and all erosion and sedimentation controls are being built and maintained as designed.

3.6 PERMIT VIOLATIONS

- A. If any violations of the provisions or requirements of the SWPPP or this Contract are noted during inspections, the Construction Manager shall notify the permittee in writing of the items needing correction. The permittee shall have three (3) calendar days to make such corrections unless given a specific extension of time in writing. Failure to complete such corrections within the specified time period shall constitute a violation of this program and will result in submittal of an Incident of Non-Compliance (ION) to the IEPA. Failure to correct deficiencies may also result in maintenance of the system by the Construction Manager as deemed necessary. If this occurs, the cost thereof shall be deducted from any compensation due, or which may become due, the Contractor under this contract.

- B. In the event that the permittee violates the terms of the construction NOI, SWPPP and/or supporting documents in such a manner as to materially adversely affect the health, welfare, or safety of persons residing or working on Owner's property or be materially detrimental to the public welfare or injurious to property or improvements on Owner property the Construction Manager shall stop work immediately. The permittee shall be solely responsible for any increased costs due to the work stoppage.
- C. No person shall construct, enlarge, alter, repair, or maintain any grading, excavation, or fill, or cause the same to be done, contrary to or in violation of any terms of this Contract or an issued permit, In addition to any other penalty authorized by this section, any person, partnership, corporation or institution found in violation of any of the provisions of this Contract shall be required to bear the expense of such restoration.

3.7 REPORT SUBMITTALS

- A. All inspection reports must be turned over to the Construction Manager upon completion of the project.

3.8 TEMPORARY EROSION CONTROL

- A. The Construction Manager has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, the surface area of erodible earth material exposed by excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds or other areas of water impoundment. Cut slopes shall be seeded and mulched as the excavation proceeds to the extent considered desirable and practicable.
- B. The Contractor shall incorporate all permanent erosion control features into the project at the earliest practicable time. In addition to existing temporary erosion control systems installed by prior contractors, the Construction Manager will require temporary erosion control at other locations to correct conditions that develop during construction; that are needed prior to installation of permanent pollution control features; or that are needed temporarily to control erosion that develops during normal construction practices but are not associated with permanent control features on the project.
- C. The Construction Manager may limit the area of site improvement operations in progress commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such permanent pollution control measures current in accordance with the approved schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately.

3.9 MAINTENANCE

- A. Temporary erosion control systems shall be installed and properly maintained by the Contractor as directed by the Construction Manager to control siltation at all times during the life of the contract and until a perennial vegetative cover of at least seventy percent is established. If the Contractor fails to maintain the temporary erosion control systems as directed by the Construction Manager, at the expiration of a period of three (3) calendar days after having given the Contractor written notice, the Construction Manager will proceed to maintain the systems as deemed necessary, and the cost thereof shall be deducted from any compensation due, or which may become due, the Contractor under this contract.
- B. Maintenance of concrete washout facilities shall conform to the following guidelines:
 - 1. Ensure that no leaks or spills are present and that the facility's capacity has not been compromised. If the facility's liner is damaged, immediately replace.
 - 2. Any overflow from washout facilities must be cleaned and removed within 24 hours of discovery.
 - 3. If a rain or snow event is forecasted, a non-collapsing, non-water collecting cover shall be placed over the washout facilities and secured to prevent accumulation of precipitation.
 - 4. Contents of each concrete washout facility are not to exceed 75% of its designed capacity. If 75% of capacity is reached, discontinue the use of this facility until it has been cleaned out. An alternate concrete washout facility will be necessary.

3.10 REMOVAL

- A. When the Construction Manager has determined the erosion and sedimentation control devices are no longer necessary, unless other directions have been given in writing, it is the contractor's responsibility for removal. Any damage inflicted during removal shall be promptly repaired.

3.11 NOTICE OF TERMINATION AND FINAL INSPECTION

- A. The permittee shall notify the Construction Manager in writing that the site has met the above conditions and a Notice of Termination (NOT) may be submitted to the IEPA. Upon notification by the permittee the Construction Manager will conduct a final inspection. If the drainage system, or erosion and sedimentation devices that are to remain in place are found to contain deficiencies which require correction the Construction Manager shall notify the permittee within 15 business days in writing of the items needing corrections. The permittee shall have five (5) calendar days to make such corrections unless given a specific extension of time in writing. Failure to complete such corrections within the specified time period shall constitute a violation of this Contract and may result in delay or non-payment of the next pay request.
- B. Upon final completion, the Construction Manager will complete and submit the NOT to the IEPA. If corrections are required prior to submittal of the NOT, the

permittee will be notified in writing within 14 working days as to the reasons. Note that a site has been finally stabilized when all land disturbing activities are complete and a uniform perennial vegetative cover with a density of 70 percent has been established or equivalent, approved, permanent stabilization measures have been used.

END OF SECTION

SECTION 32 12 22

JOINT SEALING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleaning and sealing of joints for:
 - a. Concrete sidewalks.
- B. Related Sections:
 - 1. Section 32 13 13 - Concrete Paving.

1.3 REFERENCES

- A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's product data, including recommended application rate and mixing instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Joint Sealer: Deliver joint sealer in manufacturer's original, unopened, undamaged containers and packaging. Store in dry conditions and keep packaging sealed until ready for use.

PART 2 PRODUCTS

2.1 JOINT SEALER

- A. Joint sealer shall be in accordance with IDOT Standard Specification Section 452.
- B. Backer rod:
 - 1. Closed-cell, plastic-foam, heat resistant, chemically inert, waterproof rod compatible with the sealant used.
 - 2. 1/8 inch wider in diameter than the joint it will be placed in.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 31 19 – Project Meetings: Verification of existing conditions before starting work.
- B. Verify joints to be sealed are clean, dry, and blown free of loose foreign material prior to sealant placement.
- C. Do not place joint sealer when surface temperature is outside of the Manufacturer's recommended range.

3.2 QUALITY CONTROL

- A. Joint cleaning and sealing shall be in accordance with IDOT Standard Specification Section 452.04.

3.3 PREPARATION

- A. Dust and debris shall be blown from joints with a power blower or compressed air immediately ahead of sealer placement. When compressed air is used, the minimum operating air pressure shall be 90 pounds per square inch.
- B. Joints shall be routed or sawed as necessary to dislodge foreign materials and/or to enlarge existing cracks to a sufficient width to allow penetration of joint sealer. If sawing or routing is necessary, joints shall be opened to a minimum width and depth of approximately 3/4 inch.

3.4 PLACING JOINT SEALER

- A. Sealant shall be continuously and mechanically agitated during heating when hot-poured joint sealer is used.
- B. The sealed crack shall be filled flush with the pavement surface. Under-filling of joints will not be permitted.
- C. Backer rod may be used to control the depth of sealant placed as approved by the Engineer. The minimum depth of placed sealant shall be 3/4 inch.

END OF SECTION

Section 32 13 13

CONCRETE PAVING

1. GENERAL

1.1 WORK INCLUDES

A. Base Bid:

1. General Contractor provide concrete paving for:
 - a. Concrete sidewalk.

B. Related Sections:

1. Section 31 10 16 - Aggregates.
2. Section 31 22 13 - Rough Grading.
3. Section 32 12 22 - Joint Sealing.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M194 - Standard Specification for Chemical Admixtures for Concrete.
2. AASHTO M324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

B. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

C. ASTM International:

1. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
2. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
3. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
6. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
7. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

8. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
9. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
10. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
11. ASTM C33 - Standard Specification for Concrete Aggregates.
12. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
14. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
15. ASTM C150 - Standard Specification for Portland Cement.
16. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
17. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
18. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
19. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
20. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
21. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
22. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
23. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
24. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
25. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
26. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
27. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
28. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
29. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
30. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
31. ASTM C1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.

32. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
33. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
34. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
35. ASTM E408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
36. ASTM E903 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
37. ASTM E1918 - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
38. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

D. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 SUBMITTALS

A. Product Data:

1. Concrete: Submit data on concrete materials, joint filler, admixtures and curing compounds.

B. Design Data:

1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
 - a. Hot and cold weather concrete work.
2. Identify mix ingredients and proportions, including admixtures.
3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.
4. Concrete design mix shall be in accordance with IDOT Standard Specification Section 1020.
5. Concrete shall have a minimum compressive strength of 3500 PSI at 14 days.
6. Concrete shall be of the class specified in Table 1 of IDOT Standard Specification Section 1020 for the use specified.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Obtain cementitious materials from same source throughout.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum three years experience.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

2. PRODUCTS

2.1 BASE MATERIAL

- A. Subbase Granular Material: Meeting the requirements of Specification Section 31 05 16.

2.2 FORM MATERIALS

- A. Form Materials: In accordance with IDOT Standard Specification Article 1103.05.

2.3 REINFORCING

- A. Reinforcement Bars: In accordance with IDOT Standard Specification Article 1006.10.
- B. Welded Wire Fabric: In accordance with IDOT Standard Specification Section 1006.10.

2.4 CONCRETE MATERIALS

- A. Portland Cement: In accordance with IDOT Standard Specification Section 1001.
- B. Water: In accordance with IDOT Standard Specification Section 1002.
- C. Fine Aggregate: In accordance with IDOT Standard Specification Section 1003.
- D. Coarse Aggregate: In accordance with IDOT Standard Specification Section 1004.
- E. Admixtures: In accordance with IDOT Standard Specification Section 1021. No Calcium Chloride shall be entrained into mixtures.

2.5 ADMIXTURES

- A. Concrete Admixtures: In accordance with IDOT Standard Specification Section 1021. Air-entrained agents shall conform to ASTM C260. No Calcium Chloride shall be entrained into mixtures.

2.6 ACCESSORIES

- A. Curing Compound: ASTM C309, Type 1, Class A.
- B. Joint Sealer: In accordance with IDOT Standard Specification Section 1050.
- C. Expansion Joint: Preformed bituminous expansion joint filler in accordance with IDOT Standard Specification Article 1051.03.

2.7 SOURCE QUALITY CONTROL AND TESTS

- A. Submit proposed mix design of each class of concrete to the Architect/Engineer for review prior to commencement of Work.
- B. Tests on cement, aggregates, and mixes will be performed by IDOT to ensure conformance with specified requirements. Samples will be tested in accordance with ACI 301.
- C. Concrete shall be Ready-Mixed and delivered in accordance with ASTM C94.

3. EXECUTION

3.1 EXAMINATION

- A. Verify compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.2 SUBBASE

- A. Granular Subbase: Install in accordance with IDOT Standard Specification Section 311.

3.3 PREPARATION

- A. Moisten substrate to minimize absorption of water from fresh concrete.

- B. Notify Architect/Engineer minimum 24 hours prior to commencement of concrete operations.
- 3.4 FORMING
- A. Place and secure forms and screeds to correct location, dimension, profile, and gradient.
 - B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- 3.5 REINFORCEMENT BARS AND WELDED WIRE FABRIC REINFORCING
- A. Place reinforcing as indicated on Drawings.
 - B. Interrupt reinforcing at contraction and expansion joints.
 - C. Place reinforcing to achieve paving alignment as detailed.
- 3.6 PLACING CONCRETE
- A. Concrete design mix shall meet the requirements of IDOT Standard Specification 1020.
 - B. PCC Pavement: Pavement shall be placed in accordance with IDOT Standard Specification Section 420.
 - C. PCC Sidewalk: Sidewalk shall be placed in accordance with IDOT Standard Specification Section 424.
 - D. PCC Curb / Combination Concrete Curb and Gutter: Curb shall be placed in accordance with IDOT Standard Specification Section 606 and IDOT Highway Standards 606001 and 606006.
 - E. Concrete Paved Ditch: Ditch shall be constructed in accordance with IDOT Standard Specification Section 606 and IDOT Highway Standard 606401.
 - F. Ensure reinforcing, inserts, embedded parts and preformed expansion joints are not disturbed during concrete placement.
 - G. Excessive “pushing” of concrete from one area to another is prohibited. Do not use the vibrator to transport concrete inside the forms. Concrete shall not be allowed to drop freely more than five (5) feet.
 - H. Place concrete at such a rate that it is plastic, flows readily and mixes well with previous layers. Do not vibrate excessively in one location. Place concrete

continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

3.7 JOINTS

- A. Place expansion and contraction joints as shown in the drawings.
- B. Place joint filler between paving components and buildings or other appurtenances. Recess top of filler 1/4 inch for joint sealant installation.
- C. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut into slab to a depth of 1/3 of its thickness.

3.8 FINISHING

- A. Paving: Light broom, radius to 1/8 inch radius, and trowel joint edges.
- B. Direction of Texturing: Transverse to paving direction.
- C. Inclined Vehicular Ramps: Broomed perpendicular to slope.
- D. Place curing compound and/or sealer on exposed concrete surfaces immediately after finishing.

3.9 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Do not permit pedestrian or vehicular traffic on pavement until 75 percent design strength of concrete has been achieved.

3.10 JOINT SEALING

- A. Seal joints in accordance with Specification Section 32 12 22.
- B. Separate pavement from vertical surfaces with 1/2 inch thick joint filler.
- C. Set joint filler top to required elevations. Secure to resist movement by wet concrete.

3.11 CLEANING AND REPAIRING CONCRETE

- A. Contractor is responsible for protecting all concrete until fully cured. Contractor is responsible for replacing damaged sections at his/her own expense if vandalism occurs during the curing process.
- B. Voids and gravel pockets shall be repaired as directed by the Architect/Engineer.

3.12 ERECTION TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/4 inch in 10 feet.
- B. Maximum Variation From True Position: 1/4 inch.

3.13 FIELD QUALITY CONTROL

- A. Inspect reinforcing placement for size, spacing, location, support shall be done by Testing agency.
- B. Performance of cylinder creation, as well as slump and air entrainment testing, shall be in accordance with ACI 301 and Section 1020 of the IDOT Standard Specifications and will be done by testing agency.

END 32 13 13.

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes painted markings applied to asphalt pavement.
- B. Related Sections:
 - 1. Section 32 12 13 – Concrete Paving.

1.3 REFERENCES

- A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include technical data and tested physical and performance properties.
- B. Shop Drawings: For pavement markings.
 - 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
 - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of IDOT's Standard Specification Section 780.
 - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 degrees F for alkyd materials 55 degrees F for water-based materials, and not exceeding 95 degrees F.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: Alkyd-maleic type, lead and chromate free, ready mixed, complying with AASHTO M 249; colors complying with FS TT-P-1952.
 - 1. Color: White, Black, Yellow, or Blue as indicated on the Drawings.
- B. Glass Beads: AASHTO M 247, Type I.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 0.015 inch.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
 - 2. Broadcast glass beads uniformly into wet markings at a rate of a minimum application rate of 10 lbs. per 100 square feet.

3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

Section 32 18 13

SYNTHETIC GRASS SURFACING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, tools and equipment necessary to install synthetic grass surfacing system as indicated on the plans and as specified herein; including components and accessories required for a complete installation, including but not limited to:
 - 1. Acceptance of prepared sub-base.
 - 2. Coordination with related trades to ensure a complete, integrated, and timely installation: sub- base material (tested for permeability), grading and compacting, piping and drain components (when required); as provided under its respective trade section.

1.2 PERFORMANCE REQUIREMENTS

- A. Completed synthetic grass surfacing system shall be capable of meeting the following performance requirements:
 - 1. ASTM D1338: Tuft bind. Synthetic grass surfacing shall have a tuft bind, without infill material of 8 pounds or more.

1.3 SUBMITTALS

- A. Substitutions: Other products are acceptable if in compliance with all requirements of these specifications. Submit alternate products to Architect for approval prior to bidding.
 - B. Product Substitution Procedures.
 - 1. Provide substantiation that proposed system does not violate any other manufacturer's patents, patents allowed or patents pending.
 - 2. Provide a sample copy of insured, warranty and insurance policy information.
 - 3. Provide specification sheets showing compliance
- Product Data:
- 4. Submit manufacturer's catalog cuts, material safety data sheets (MSDS), brochures, specifications; preparation and installation instructions and recommendations.
 - 5. Submit fiber manufacturer's name, type of fiber and composition of fiber.
 - 6. Submit data in sufficient detail to indicate compliance with the contract documents.
 - 7. Submit manufacturer's instructions for installation.
- C. Samples: Submit samples, illustrating details of finished product in amounts as required, or as requested by Architect.
 - D. List of existing installations: Submit list including respective Owner's representative and telephone number.
 - E. Warranties: Submit warranty and ensure that forms have been completed in Owner's name and registered with approved manufacturer.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engaged in manufacturing synthetic grass surfacing products for a minimum of five (5) years.
 - 1. The Manufacturer shall be experienced in the manufacturing and installation of specified type of synthetic grass surfacing system. This includes use of a slit-film fiber, thatch fiber, backing, the backing coating, and the installation method.
 - 2. The Manufacturer shall own and operate its own manufacturing plant. Manufacturing the fiber, tufting of the fibers into the backing materials and coating of the synthetic grass system must be done in-house by manufacturer. The Manufacturer must hold ISO 9001, ISO 14001 and ISO 45001 certifications demonstrating its manufacturing efficiency with regards to quality, environment and safety management systems.
- B. Installer/Contractor Qualifications: Company shall specialize in performing the work of this section.
 - 1. The Company shall provide competent workmen skilled in this specified type of synthetic grass system installation.
 - 2. The designated Supervisory Personnel on the project shall be certified, in writing by the manufacturer, as competent in the installation of specified type of synthetic grass system, including gluing seams.
- C. Pre-Installation Conference: Conduct conference at project site at time to be determined by Contractor. Review methods and procedures related to installation including, but not limited to, the following:
 - 1. Inspect and discuss existing conditions and preparatory work performed under other contracts.
- D. The Installer/Contractor shall verify special conditions required for the installation of the synthetic grass system if required.
- E. The Installer/Contractor shall notify the Architect of any discrepancies.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store components with labels intact and legible.
- B. Store materials/components in a secure manner, under cover and elevated above grade.
- C. Protect from damage during storage, handling, and installation. Protect from damage by other trades.
- D. Inspect all delivered materials and products to ensure they are undamaged and in good condition.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the Work with installation of work of related trades as the Work proceeds.
- B. Sequence the Work in order to prevent deterioration of installed system.

1.7 WARRANTY

- A. The Installer/Contractor shall provide a warranty to the Owner that covers defects in materials of the synthetic grass product for a period of five (5) years from the date of completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER AND DISTRIBUTOR

- A. Approved Manufacturers include but are not limited to:
 - 1. FieldTurf, Inc.
 - 2. AstroTurf
 - 3. Challenger Turf, Inc.
 - 4. Tencate Grass
- B. Basis of Design: Powerplay Pro with 5 mm pad by FIELDTURF.

2.2 MATERIALS AND PRODUCTS

- A. Synthetic grass surfacing system shall consist of the following:
 - 1. Synthetic grass surfacing made with a combination of slit-film fibers and thatch fibers
 - 2. Attached Pad: 5mm urethane pad
 - 3. Infill: No infill required
 - 4. Glue, seaming fabric and other materials used to install and mark the synthetic grass.
 - 5. Perimeter transition material.
- B. Synthetic grass surfacing system shall have the following properties:

<u>Standard</u>	<u>Property</u>	<u>Specification</u>
ASTM D1577	Fiber Denier	10,000 +
ASTM D1577	Secondary Fiber Denier	5,000
ASTM D5823	Pile Height	0.75"
ASTM D5793	Stitch Gauge	3/16"
ASTM D5848	Pile Weight	40 oz/square yard
ASTM D5848	Primary Backing	8+ oz/square yard
ASTM D5848	Secondary Backing	20+ oz/square yard
N/A	5mm Urethane Pad	61+ oz/square yard
ASTM D5848	Total Weight (including pad)	129+ oz/square
yard ASTM D1338	Tuft Bind (Without Infill)	8lbs
N/A	Infill Component	NA

Variation of +/- 5% on above listed property values is within normal manufacturing tolerances

2.3 QUALITY CONTROL IN MANUFACTURING

- A. The manufacturer shall own and operate its own manufacturing plant in North America
- B. The manufacturer shall have full-time certified in-house inspectors at their manufacturing plant that are experts with industry standards.
- C. The manufacturer’s full-time in-house certified inspectors shall perform pre-tufting fiber testing on tensile strength, elongation, tenacity, and denier, upon receipt of fiber spools from fiber manufacturer.
- D. Primary backing shall be inspected by the manufacturer’s full-time certified in-house inspectors before tufting begins.
- E. The manufacturer’s full-time in-house certified inspectors shall verify “pick count”, yarn density in relation to the backing, to ensure the accurate amount of face yarn per square inch.

- F. The manufacturer's full-time, in-house, certified inspectors shall perform product inspections at all levels of production including during the tufting process and at the final stages before the synthetic grass is loaded onto the truck for delivery.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that all sub-base leveling is complete prior to installation.
- B. Installer/Contractor shall examine the surface to receive the synthetic grass and accept the sub-base planarity in writing prior to the beginning of installation
 - 1. Acceptance is dependent upon the Owner's test results indicating compaction and planarity are in compliance with manufacturer's specifications.
 - 2. The surface shall be accepted by Installer as "clean" as installation commences and shall be maintained in that condition throughout the process.
- C. Correct conditions detrimental to timely and proper completion of Work.
- D. Do not proceed until unsatisfactory conditions are corrected.
- E. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Prior to the beginning of installation, inspect the sub-base for tolerance to grade.
- B. Sub-base acceptance shall be subject to receipt of test results (by others) that sub-base is in compliance with manufacturer's specifications and recommendations.
- C. When requested by Architect, installed sub-base shall be tested for porosity prior to the installation of the synthetic grass system.

3.3 INSTALLATION

- A. The installation shall be performed in full compliance with approved Shop Drawings.
- B. Only trained technicians, skilled in the installation of synthetic grass systems working under the direct supervision of the approved installer supervisors, shall undertake any cutting, sewing, gluing and shearing.
- C. The designated Supervisory personnel on the project must be certified, in writing by the manufacturer, as competent in the installation of this material, including gluing seams.
- D. Install at location(s) indicated, to comply with final shop drawings, manufacturers'/installer's instructions.
- E. The Installer/Contractor shall strictly adhere to specified procedures. Any variance from these requirements shall be provided in writing, by the manufacturer's on-site representative, and submitted to the Architect and/or Owner, verifying that the changes do not in any way affect the Warranty.
- F. Synthetic grass system shall be installed directly over the properly prepared concrete floor. Extreme care shall be taken to avoid disturbing the base.

1. Repair and properly compact any disturbed areas of the base as recommended by manufacturer.
2. Seams shall be flat, tight, and permanent with no separation or fraying.
3. As it relates to adhesives used to fully glue the COMMAND POWERPLAY PRO product to the concrete base - a premium urethane adhesive is recommended. Follow the adhesive manufacturer's recommendations for trowel size and spread rates.

3.4 PROTECTION

Protect completed synthetic grass surfacing system throughout construction process until project completed.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fence framework, fabric, and accessories.
 - 2. Excavation for post bases.
 - 3. Concrete foundation for posts and center drop for gates.
 - 4. Manual gates and related hardware.
 - 5. Site Grounding.

- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 31 22 13 - Rough Grading.
 - 3. Section 31 23 16 - Excavation.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A116 - Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric.
 - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
 - 5. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
 - 6. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric.
 - 7. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 8. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 9. ASTM A817 - Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire, Type II Galvanized, Class 2, 9 Gauge.
 - 10. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - 11. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 12. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 13. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

14. ASTM F552 - Standard Terminology relating to Chain Link Fencing.
 15. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
 16. ASTM F626 - Standard Specification for Fence Fittings.
 17. ASTM F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric, Class 2a.
 18. ASTM F669 - Standard Specification for Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence, Group IA Schedule 40.
 19. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
 20. ASTM F934 - Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials, Black.
 21. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
 22. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures, Schedule 40.
 23. ASTM F1183 - Standard Specification for Aluminum Alloy Chain Link Fence Fabric.
 24. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.
 25. ASTM F1345 - Standard Specification for Zinc - 5% Aluminum -Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric.
- B. AASHTO - American Association of State Highway and Transportation Officials:
1. AASHTO M181 - Chain-Link Fence.
 2. AASHTO M232 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 3. AASHTO M279 - Metallic-Coated, Steel Woven Wire Fence Fabric.
- C. Chain Link Fence Manufacturers Institute:
1. CLFMI - Product Manual.
- D. Institute of Electrical and Electronic Engineers:
1. IEEE 80 - Guide for Safety in AC Substation Grounding.
 2. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 3. IEEE C2 - National Electrical Safety Code.
- E. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SYSTEM DESCRIPTION

- A. Fence Height: Match existing.
- B. Line Post Spacing: At intervals not exceeding 10 feet.
- C. Fence Post and Rail Strength: Conform to ASTM F1043 Heavy Industrial Fence quality.
- D. Rod electrode for local grounding at fencing and structures.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, schedule of components and layout and installation of grounding components.
- C. Product Data: Submit data on fabric, posts, accessories, fittings, hardware, grounding electrodes and connectors.
- D. Manufacturer's Installation Instructions: Submit installation requirements.
- E. Test Reports: Indicate overall resistance to ground.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Accurately record actual locations of perimeter posts relative to property lines, electrodes and connections.
- C. Operation and Maintenance Data: Procedures for submittals.

1.6 QUALITY ASSURANCE

- A. Supply material in accordance with CLFMI - Product Manual.
- B. Perform installation in accordance with ASTM F567, IEEE 142 and IEEE 80.
- C. Perform Work in accordance with Illinois Department of Transportation Standard Specification Section 664 and the details provided in the plans.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum five years experience.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
- C. Identify each package with manufacturer's name.
- D. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 COMPONENTS

- A. Components shall be as follows:
 - 1. 4" O.D. gate post (9.10 lb/ft);
 - 2. 2-7/8" O.D. terminal post (5.79 lb/ft);
 - 3. 2-3/8" O.D. line post (3.65 lb/ft), spaced a maximum of 10 feet apart;
 - 4. 1-5/8" O.D. top rail, bottom rail and bracing (2.27 lb/ft);
 - 5. 9 gauge, zinc coated wire;

2.2 ACCESSORIES

- A. Chain link fabric shall be Type I, Class D (zinc coated steel) in accordance IDOT Standard Specifications and the project plans. The fabric shall be 2 inch (a tolerance of plus or minus 1/8 inch will be permitted) diamond mesh interwoven wire, 9 gage thick (0.148 inch nominal diameter), top salvage knuckle end closed, bottom selvage twisted tight. Wire constituting the fabric shall have a minimum tensile strength of 80,000 psi based on the coated wire diameter. The fabric shall be coated with prime western spelter or equal uncoated wire surface weaving. The mesh size shall be measured in either direction as the minimum clear distance between the wires forming the parallel sides of the mesh.
- B. Chain link fabric, line posts, terminal posts, gate posts, tension wires, gate frames, stretcher bars, fabric ties, fittings, latches, bolts and nuts, fabric ties and horizontal braces shall be of the same materials as the fabric and in accordance with Section 664 of the IDOT Standard Specifications and the project plans.
- C. Truss Rods shall be in accordance with Section 664 of the IDOT Standard Specifications.
- D. Post Tops: Cast steel galvanized; sized to post diameter, set screw retainer in accordance with Section 664 of the IDOT Standard Specifications.
- E. Gate Hardware for Fence: Gate stop and latch with provisions for padlocking. Gate hinges shall be of sufficient strength to sustain the weight of the gate used in the application.
- F. Concrete: Type specified in Section 03 30 00.
- G. Caps: Cast steel galvanized, zinc coated, sized to post diameter, set screw retainer.
- H. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.
- I. Gate Hardware: Center gate stop and drop rod two 180 degree gate hinges for each leaf and hardware for keyed padlock.

2.3 GATES

- A. General:

1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
2. Factory assemble gates of 2" O.D. pipe with welded joints. Weld areas repaired with zinc-rich coating applied per manufacturer's directions, and fabric to match fence.
3. Design gates for operation by one person.
4. Gate accessories, hinges, latches, center stops, keepers and necessary hardware of quality required for industrial and commercial application.
5. Latches shall permit padlocking.

B. Swing Gates:

1. Fabricate gates to permit 180 degree swing.
2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

2.4 FINISHES

- A. Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 1.8 oz/sq ft coating.

2.5 SITE GROUNDING

A. Rod Electrodes

1. Product Description: Copper-clad steel ground rods.
2. Diameter: 3/4 inch.
3. Length: 10 feet.

B. Exothermic Connections

1. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

C. Mechanical Connectors

1. Furnish materials in accordance with Jefferson County Building Department standards.
2. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

D. Wire

1. Material: Solid copper.
2. Connections to Electrodes: 8 AWG, minimum size.
3. Bonding Other Objects: 8 AWG, minimum size.
4. Mechanical Connector: Bronze.
5. Grounding Boxes: Bronze.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567. The contractor shall fill, cut or trench where necessary to produce a smooth and uniform

ground surface so the bottom of the fabric is not more than 2 inches above the finished ground line.

- B. Set intermediate, line, corner, terminal, and gate posts plumb, true to line and grade, in concrete footings with top of footing 2 inches above finish grade. Footing shall be of a commercial concrete mixture. The concrete shall be of a uniform thickness around the post. Slope top of concrete to have a cone or dome shaped for water runoff.
- C. Intermediate, line, corner, terminal, and gate post footing depth below finished grade: Four (4) feet deep, concrete 12" diameter. All posts shall have a maximum spacing of 10 feet.
- D. Install top rail continuous from terminal post, connected with outside sleeve couplings, either screw or self centering type, every fifth one of which in any continuous length shall be slip coupling with an enclosed compression spring. Install the top rail through line post tops, but shall be secured at all corner posts.
- E. Fabric shall be attached to end, corner and pull posts with stretcher bar bands spaced at 10 inch to 12 inch centers, and to the outside of the top rails, intermediate rails, bottom rails, braces, bottom tension wire and line posts with tie wires. All fabric shall be pulled taut by approved hand powered mechanical means before it is attached to top rails, intermediate rails, bottom rails, braces, bottom tension wire or line posts.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
- G. Do not attach to posts or stretch fabric until concrete foundation has cured 28 days.
- H. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- I. Position bottom of fabric 2 inches above finished grade.
- J. Fasten fabric to top rail, intermediate rail, bottom rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- K. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- L. Install bottom rail or bottom tension wire stretched taut between terminal posts, full length of fence.
- M. Support gates from gate posts. Do not attach hinged side of gate from building wall.
- N. Install gate with fabric to match fence. Install three hinges on each gate leaf, latch, catches, drop bolt foot bolts and sockets.
- O. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- P. Connect to existing fence at existing terminal post.

- Q. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.
- R. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.
- S. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.
- T. The finished fence shall be in proper alignment with posts plumb and chain link fabric pulled taut. Care shall be exercised to equalize the tension of the full width of the fabric. Wire fabric shall be securely fastened to the posts and all other fence components.
- U. Verify final backfill and compaction has been completed before driving rod electrodes. Install rod electrodes in vertical position with top at least 12 inches below finished grade level.

3.2 GROUNDING

- A. Ground fence enclosures at diagonally opposite corners and at intervals not exceeding 500 feet.
- B. Where an electric utility line rated 600 volts or greater passes over the fence, fence shall be grounded at points 50 feet, measured horizontally, beyond where the outside conductors pass over the fence.
- C. Where an electric utility line rated 600 volts or greater runs parallel to and within 40 feet of the fence, measured horizontally, fence shall be grounded at 50 feet maximum intervals along the parallel section of fence.
- D. Fence post grounding shall consist of conductors secured to the fence with compression connectors.
- E. Provide ground rod at each grounding point located on post side of fence as close as possible to post and fence.
- F. Grounding conductors shall be connected to the ground rod with an exothermic welded or mechanical connection. Grounding conductors shall be clamped to the fence with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, gates, and ground rods.
- G. Ground fence on each side of all gates, at each corner. Provide flexible copper bonding jumper between fixed fencing and moveable elements such as gates. Bond metal gates to gate posts.
- H. Bond across openings, with and without gates. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

- I. Connections: Make connections so the possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connection with tin-plated jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

- J. Total resistance of the fence to ground shall not be greater than 25ohms.

3.3 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.

3.4 FIELD QUALITY CONTROL

- A. Sections 01 40 00 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Inspect and test site grounding in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.

3.5 CERTIFICATION

- A. Prior to installation of the chain link fence, the manufacturer shall supply the Engineer with certification that all materials used fully comply with these specifications.

END OF SECTION

SECTION 32 31 23

EXTRUDED VINYL FENCING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rigid polyvinyl chloride (PVC) fencing sections, profiles and accessories, including pickets, rails, posts and caps.

1.2 Related Sections:

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.
2. Section 31 00 00 Earthwork
3. Section 32 00 0 Paving and Surfacing

1.3 REFERENCES

- A. ASTM D4216 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Related Plastic Building Product Compounds
- B. ASTM F964-09 - Standard Specification for Rigid Poly (PVC) Exterior Profiles Used for Fencing and Railing.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Submit manufacturer's product data, including style, installation instructions and certification of compliance with material specifications.

B. Shop Drawings: For each type of fence and gate assembly.

1. Showing fence design, style and colors or woodgrains, layout of fence and gates with dimensions and specified options, including details and finishes of component accessories and post foundations.

C. Samples for Initial Selection:

1. Submit manufacturer's color (35) or wood grain (5) samples in form of actual product and in color selection.

1.5 WARRANTY

- A. Provide manufacturer's 20 year non-prorated warranty.

1.6 QUALITY ASSURANCE

- A. Engage an experienced installer who has at least three years experience and has completed at least five PVC fence projects with the same material and similar scope to that indicated for this project with a successful construction record of in-service performance.
- B. Obtain PVC fences and gates, including accessories, fittings and fastenings, from a single source.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation in a secure and dry place.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for vinyl fences and gates in relationship to erected new construction and installed mechanical equipment. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Design based on products by Illusions Vinyl Fence
- B. Substitute as approved by A/E

2.2 MATERIALS

- A. Products from other qualified manufacturers having a minimum of 5 years experience manufacturing PVC fencing will be acceptable by the architect as equal, if approved in writing ten days prior to bidding, and if they meet the following specifications for design, fabrication, and color and/or woodgrain. PVC Profiles, lineals & extrusions used as components must "meet or exceed" the minimum performance guidelines laid out in ASTM F964-09.
- B. Pickets, rails, and posts prefabricated sections using Rigid Poly Vinyl Chloride (PVC) compounds for exterior-profile extrusions with cell classification of 1-32333-3 as defined by ASTM D4216, that meets or exceeds the following proprieties:

1. Color/Consistency Testing – The PVC compound in extruded section shall maintain uniform color and be free of any visual surface or structural changes, such as peeling, chipping, cracking, flaking, or pitting after weathering at intervals of six months and one year for white and for six months, one year, and two years for all other colors in a hot, dry climate such as Phoenix, AZ; a hot humid climate such as Miami, FL; and a temperate northern climate, when tested in accordance with ASTM Performance Weathering Requirements.

2. Weathering Testing – The PVC compound shall have a minimum impact resistance of 0.6in.-lb/mil (2670 J/m) after weathering six months and one year in a hot, dry climate such as Phoenix, AZ; a hot, humid climate such as Miami, FL; and a temperate northern climate, when tested in accordance with ASTM Performance Weathering Requirements. The PVC compound shall have successfully met the weathering requirements prescribed for six months at each climatic testing site prior to use in production of exterior-profile extrusions, when tested in accordance with ASTM Performance Weathering Requirements.

3. ASTM Specifications Met:
 - D256** – To determine Izod impact properties
 - D618** – Practice for Conditioning Plastics for Testing
 - D635** – Test Method for Rate of Burning and/or Extent and Time of Burning Plastics in a Horizontal Position
 - D638** – To determine tensile properties
 - D648** – To determine heat distortion temperature
 - D696** – Test Method for Coefficient of Linear Thermal Expansion of Plastics between 0°30°C and 30°C with a Vitreous Silica Dilatometer
 - D790** – To determine flexural properties
 - D792** – To determine specific gravity
 - D883** – Terminology Relating to Plastics
 - D1435** – Practice for Outdoor Weathering of Plastics
 - D1600** – Terminology for Abbreviated Terms Relating to Plastics
 - D1784** – Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
 - D1898** – Practice for Sampling of Plastics
 - D2240** – To determine Shore hardness values
 - D2244** – Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
 - D2565** – Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications
 - D4216** – Material Class Number 1-32333-3. To establish Cell Classification of PVC Material. Illusions compounds have a higher cell classification because one or more properties are superior to those used in standard acceptable compounds.
 - D4226** – Test Methods for Impact Resistance of Rigid Poly (Vinyl Chloride) (PVC) Building Products
 - D4726** – Specification for Rigid Poly (Vinyl Chloride)

2.3 PVC VINYL FENCE PREFABRICATED SECTIONS

A. Style:

1. Semi-Privacy

B. Height: 8 feet

- C. Width, Nominal Center to Center of Posts: 8 feet.
- D. Bend: Straight
- E. Base Vertical Color: To be selected by A/E or owners representative from manufacturers standard colors.
- F. Post Options: 5" x 5" H.D, - .250 wall – To be selected by A/E or owners representative from manufacturers standard colors.
- G. Post Cap Style: Flat V55FO - To be selected by A/E or owners representative from manufacturers standard colors.
- H. Top Horizontal Color - To be selected by A/E or owners representative from manufacturers standard colors.
- I. Mid Horizontal Color - To be selected by A/E or owners representative from manufacturers standard colors.
- J. Bottom horizontal Color - To be selected by A/E or owners representative from manufacturers standard colors.
- K. U-Channel Color: - To be selected by A/E or owners representative from manufacturers standard colors.

2.4 GATE HARDWARE AND ACCESSORIES

- A. General: Provide hardware and accessories for each gate according to the following requirements:
- B. Hinges: Size and material to suit gate size, non lift-off type. Provide three hinges for each gate. Use Illusions (#IESH) extra strong hinges.
- C. Color: To be selected by A/E or owners representative from manufacturers standard colors.
- D. Latch: Manufacturer's standard self-latching, stainless steel composition single or dual access gravity latch. Provide one latch per gate. (#HLSS)
- E. Finish: Match gate hinge finish.
- F. Hardware: Stainless Steel. Provide sizes as recommended by fence manufacturer.
- G. Finish: Match gate hinge finish.
- H. Accessory Items:
 1. Use one drop rod set per gate leaf.
 2. Use one gate stop per gate set up.
 3. Use one gate handle per gate.

2.5 MISCELLANEOUS MATERIALS

- A. In high wind area, use Illusions 75 mph wind kits to meet Miami-Dade County Minimum Wind Standard.

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 Engineer.
- B. Consult local code officials for compliance to building code requirements.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FENCE INSTALLATION

- A. Excavation: Drill or hand-excavate (using post hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
 - 1. If not on drawings, excavate holes for each post to a minimum diameter 12"
 - 2. Unless otherwise indicated, excavate hold depths not less than 30 inches or to frost line.
- B. Posts: Install posts in one piece per prefabricated section, plumb and in line. Installation method is one post and one section at a time for proper spacing.
 - 1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations.
 - a. Unless otherwise indicated, terminate top of concrete footings 3 inches below adjacent grade and trowel to a crown to shed water.
 - b. Secure posts in position with prefabricated section with manufacturer's recommendations until concrete sets.
 - c. Install post caps
 - d. Remove concrete splatters from PVC fence materials with care to avoid scratching.
- C. Fence Installation at Sloping Terrain: At sloping terrain, rails may be racked (sloped) or stepped to comply with manufacturer's recommendations.

3.3 GATE INSTALLATION

- A. Use heavy duty gate posts (.250 wall) 5" x 5" or 8" x 8" per manufacturer's recommendations. Bottom rail should include minimum (2) 1/4" drainage holes.
- B. Install gates plumb, level, and secure for full opening without interference according to manufacturer's instructions.
- C. Gate Latch Installation. Install gate latch according to manufacturer's instructions. Adjust for smooth, trouble-free operation. Use Illusions extra strength hinges. (#IESH)

- D. Allow minimum 72 hours to let concrete set-up before opening gates.

3.4 CLEANING

- A. Clean up all debris and unused material and remove from the site.

3.5 DEMONSTRATION

- A. Instruct the owner's personnel on proper operation and maintenance of fence components.

END OF SECTION

SECTION 32 91 19
LANDSCAPE GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Final grade topsoil for finish landscaping.
- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 23 16 - Excavation and Fill.
 - 3. Section 31 05 13 - Soils.

1.2 REFERENCES

- A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures
- B. Samples: Submit, in air-tight containers, a 10 lb. sample of each type of fill to the Architect/Engineer.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish each topsoil material from single source throughout the Work.
- B. Perform Work in accordance with IDOT Standard Specification Section 211.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Topsoil: From site.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify building and trench backfilling have been inspected.
- C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect existing structures, fences, sidewalks, utilities, paving and curbs.

3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches and stones, in excess of 1 inch in size. Remove contaminated subsoil.
- C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

- A. Place topsoil in areas where seeding will occur to nominal depth of 6 inches. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to plant material, building, and paved areas to prevent damage.
- E. Roll placed topsoil.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

B. Prohibit construction traffic over topsoil.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fertilizing.
 - 2. Seeding.
 - 3. Mulching.
 - 4. Maintenance.

- B. Related Sections:
 - 1. Section 31 22 13 - Rough Grading.
 - 2. Section 31 23 16 - Excavation and Fill.
 - 3. Section 32 05 13 - Soils.
 - 4. Section 31 23 17 - Trenching.
 - 5. Section 32 91 19 - Landscape Grading.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C602 - Standard Specification for Agricultural Liming Materials.

- B. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, 2022, and all addenda. References made to compensation, method of measurement and basis of payment shall not apply.

1.3 DEFINITIONS

- A. Weeds: Vegetative species other than specified species to be established in given area.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit data for seed mix, fertilizer, mulch, and other accessories.

- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 FINAL ACCEPTANCE

- A. Final inspection and acceptance will be at the end of the turf establishment period. Acceptance shall be based upon a satisfactory stand of turf defined as 95 percent ground cover of species established.

- B. Reestablish turf in areas that do not have 95 percent ground cover of the established species. Repair rejected areas of turf within acceptable planting dates as directed by Architect/Engineer.
- C. Upon seeded areas acceptance, submit written maintenance instructions recommending procedures for maintenance of seeded areas.

1.6 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.
- B. Work shall be performed by a landscape contractor with a minimum of 5 years of full-time experience in the work specified and with workers skilled in the work specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- D. Store all products off the ground, in a dry location, out of the way of construction operations. Provide protection to prevent damage until installed.

1.8 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.
- B. Maintenance of installed and accepted seeded areas will be performed by Owner.
- C. Maintain seeded lawn areas, including watering, spot weeding, mowing, applications of herbicides, fungicides, insecticides and re-seeding until a full, uniform stand of grass free of weeds, undesirable grass species, disease, and insects is achieved and accepted.
 - 1. Water daily to maintain adequate surface soil moisture for proper seed germination. Continue daily watering for not less than 30 days. Thereafter, apply 1/2" of water twice weekly until acceptance.
 - 2. Repair, rework, and re-seed all areas that have washed out, are eroded, or do not catch.
 - 3. Mow lawn areas as soon as lawn top growth reaches a 3 inch height. Cut back 2 inches in height. Repeat mowing as required to maintain specified height.
 - 4. Apply Type B fertilizer to lawns approximately 30 days after seeding at a rate equal to 1.0 lb. Of actual nitrogen per 1,000 square feet. (140

lbs./acre). Apply with mechanical rotary or drop type distributor.
Thoroughly water into soil.

1.9 WARRANTY

- A. Contractor's Warranty: Supply Owner with warranty in accord with General Conditions for a period of one year plus one growing season.

PART 2 PRODUCTS

2.1 SEED MIXTURE

- A. Seed shall be in accordance with IDOT Standard Specification Article 1081.04.
- B. Seed mix shall be a Class 1 lawn mixture in accordance with IDOT Standard Specification Article 250.07.

2.2 ACCESSORIES

- A. Mulching Material: In accordance with IDOT Standard Specification Article 1081.06.
- B. Fertilizer: In accordance with IDOT Standard Specification Article 1081.08.
- C. Lime: Agricultural ground limestone in accordance with IDOT Standard Specification Article 1081.07.
- D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.
- E. Erosion Fabric: In accordance with IDOT Standard Specification Article 1081.15.
- F. Stakes: Softwood lumber, chisel pointed.
- G. String: Inorganic fiber.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify prepared soil base is ready to receive the Work of this section. Do not start seeding work until unsatisfactory conditions are corrected.

3.2 FERTILIZING

- A. Apply fertilizer in accordance with IDOT Standard Specification Article 250.04.
- B. Apply lime at application rate recommended by soil analysis. Work lime into top 6 inches of soil.
- C. Apply each fertilizer at the rate of 90 lb/acre.
- D. Apply after smooth raking of topsoil and prior to roller compaction.
- E. Do not apply fertilizer at same time or with same machine used to apply seed.
- F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

- A. Apply seed in accordance with IDOT Standard Specification Section 250.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.
- D. Immediately following seeding, apply mulch in accordance with IDOT Standard Specification Section 251. Mulch Method 1 shall be used.
- E. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 REPAIR OF SEEDING

- A. The Contractor is responsible for the proper care of the seeded areas during the period when the vegetation is being established. If, at any time before completion and acceptance of the entire work covered by this contract, any portion of the surface becomes eroded, gullied or otherwise damaged or vandalized following seeding; has been winter-killed or otherwise destroyed, the affected portion shall be repaired to re-establish the condition and grade of the soil and reseed the areas as specified herein to attain established turf.

3.5 SEED PROTECTION

- A. Cover seeded slopes where grade is 4:1 or greater when matting. Roll erosion control blanket down over slopes without stretching or pulling.
- B. Lay erosion control blanket smoothly on soil surface, burying top end of each section in narrow 6-inch trench. Leave 12-inch overlap from top roll over bottom roll. Leave 4-inch overlap over adjacent section.
- C. Staple outside edges and overlaps at 36-inch intervals.

- D. Lightly dress slopes with topsoil to ensure close contact between matting and soil.
- E. In ditches, unroll matting in direction of flow. Overlap end of strips six inch with upstream section on top.

3.6 MAINTENANCE

- A. Mow grass at regular intervals to maintain at maximum height of 3 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.
- D. Water to prevent grass and soil from drying out.
- E. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- F. Immediately reseed areas showing bare spots.
- G. Repair washouts or gullies.
- H. Protect seeded areas with warning signs during maintenance period.

3.7 ACCEPTANCE

- A. Inspection to determine acceptance of seeded lawns will be made after 60 days of completed installation upon Contractor's request. Provide notification at least ten working days before requested inspection date.
 - 1. Seeded areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy, uniform, close stand of specified grass is established free of weeds, undesirable grass species, disease, and insects.
 - 2. No individual lawn areas shall have bare spots or unacceptable cover totaling more than two percent of the individual areas, in areas requested to be inspected.
- B. Upon acceptance, Owner will assume lawn maintenance.

3.8 CLEANING

- A. Perform cleaning during installation of work and upon completion of work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from seeding operations.

END OF SECTION

SECTION 33 01 32

SEWER AND MANHOLE TESTING

1. GENERAL

1.1 WORK INCLUDES

A. Base Bid:

1. Contractor provide:
 - a. Testing Manholes: Vacuum Test.
 - b. Testing Gravity Sewer Piping: Low-pressure Air Test.
 - c. Hydrostatic Testing Pressure Piping.
 - d. Deflection Testing Plastic Piping.

1.2 REFERENCES

A. ASTM International:

1. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
2. ASTM D2122 - Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

1.3 SUBMITTALS

- A. Test Reports: Indicate results of manhole and piping tests.

2. PRODUCTS

2.1 VACUUM TESTING EQUIPMENT

- A. Vacuum pump.
- B. Vacuum line.
- C. Vacuum tester base with compression band seal and outlet port.
- D. Shut-off valve.
- E. Stop watch.
- F. Plugs.
- G. Vacuum gauge, calibrated to 0.1 inch Hg

2.2 AIR TEST EQUIPMENT

- A. Air compressor.
- B. Air supply line.
- C. Shut-off valves.
- D. Pressure regulator.
- E. Pressure relief valve.
- F. Stop watch.
- G. Plugs.
- H. Pressure gauge, calibrated to 0.1 psi.

2.3 HYDROSTATIC TEST EQUIPMENT

- A. Hydro pump.
- B. Pressure hose.
- C. Water meter.
- D. Test connections.
- E. Pressure relief valve.
- F. Pressure gauge, calibrated to 0.1 psi.

2.4 DEFLECTION TEST EQUIPMENT

- A. Go, No-Go mandrels.
- B. Pull/retrieval ropes.

3. EXECUTION

3.1 EXAMINATION

- A. Verify manholes and piping are ready for testing.
- B. Verify trenches are backfilled.
- C. Verify pressure piping concrete reaction support blocking or mechanical restraint system is installed.

3.2 PIPING PREPARATION

A. Lamping:

1. Lamp gravity piping after flushing and cleaning.
2. Perform lamping operation by shining light at one end of each pipe section between manholes; observe light at other end; reject pipe not installed with uniform line and grade; remove and reinstall rejected pipe sections; re-clean and lamp until pipe section achieves uniform line and grade.

B. Plug outlets, wye-branches and laterals; brace plugs to resist test pressures.

3.3 FIELD QUALITY CONTROL

A. Testing Gravity Sewer Piping:

1. Low-pressure Air Test:
 - a. Test each section of gravity sewer piping between manholes.
 - b. Introduce air pressure slowly to approximately 4 psig.
 - 1) Determine ground water elevation above spring line of pipe for every foot of ground water above spring line of pipe, increase starting air test pressure by 0.43 psig; do not increase pressure above 10 psig.
 - c. Allow pressure to stabilize for at least five minutes. Adjust pressure to 3.5 psig or increased test pressure as determined above when ground water is present. Start test.
 - d. Test:
 - 1) Determine test duration for sewer section with single pipe size from the following table. Do not make allowance for laterals.

Nominal Pipe Size, Inches (mm)	Minimum Test Time, min/ 100 feet
3	0.2
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

- 1) Record drop in pressure during test period; when air pressure has dropped more than 1.0 psig during test period, piping has failed; when 1.0 psig air pressure drop has not occurred during test period, discontinue test and piping is accepted.
- 2) When piping fails, determine source of air leakage, make corrections and retest; test section in incremental stages until leaks are isolated; after leaks are repaired, retest entire section between manholes.
2. Test pipe larger than 36 inches diameter with exfiltration test not exceeding 100 gallons for each inch of pipe diameter for each mile per day for each section under test. Perform test with minimum positive head of 2 feet.
3. Infiltration Test:
 - a. Use only when gravity piping is submerged in ground water minimum of 4 feet above crown of pipe for entire length being tested.
 - b. Maximum Allowable Infiltration: 100 gallons per inch of pipe diameter for each mile per day for section under test, include allowances for leakage from manholes. Perform test with minimum positive head of 2 feet.

B. Testing Pressure Sewer Piping:

1. Hydrostatic Leakage Test:

- a. Hydrostatically test each portion of pressure piping, including valved section, at 1.5 times working pressure of piping based on elevation of lowest point in piping corrected to elevation of test gauge.
- b. Fill section to be tested with water slowly, expel air from piping at high points. Install corporation cocks at high points. Close air vents and corporation cocks after air is expelled and raise pressure to specified test pressure.
- c. Observe joints, fittings and valves under test. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage. Retest.
- d. Correct visible deficiencies and continue testing at same test pressure for additional 2 hours to determine leakage rate. Maintain pressure within plus or minus 5.0 psig of test pressure. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
- e. Compute maximum allowable leakage by the following formula:

$L = (SD\sqrt{P})/C$
L = allowable, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of pipe, in inches
p = average test pressure during leakage test, in psig
C = 148,000
When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

- f. When test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections and retest until leakage is within allowable limits. Correct visible leaks regardless of quantity of leakage.

C. Deflection Testing of Plastic Sewer Pipe:

1. Perform vertical ring deflection testing on PVC and ABS sewer piping, after backfilling has been in place for at least 30 days but not longer than 12 months.
2. Allowable maximum deflection for installed plastic sewer pipe limited to 5 percent of original vertical internal diameter.
3. Perform deflection testing using properly sized rigid ball or 'Go, No-Go' mandrel.
4. Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe as determined by ASTM standard to which pipe is manufactured. Measure pipe in compliance with ASTM D2122.
5. Perform test without mechanical pulling devices.
6. Locate, excavate, replace and retest pipe exceeding allowable deflection.

D. Testing Manholes:

1. General: Test using air whenever possible prior to backfilling to assist in locating leaks. Make joint repairs on both outside and inside of joint to ensure permanent seal. Test manholes with manhole frame set in place.
2. Vacuum test in accordance with ASTM C1244 and as follows:
 - a. Plug pipe openings; securely brace plugs and pipe.
 - b. Inflate compression band to effect seal between vacuum base and structure; connect vacuum pump to outlet port with valve open; draw vacuum to 10 inches of Hg; close valve; start test.
 - c. Test:
 - 1) Determine test duration for manhole from the following table:

Manhole Diameter	Test Period
4 feet	60 seconds
5 feet	75 seconds
6 feet	90 seconds

- 2) Record vacuum drop during test period; when vacuum drop is greater than 1 inch of Hg during test period, repair and retest manhole; when vacuum drop of 1 inch of Hg does not occur during test period, discontinue test and accept manhole.
- 3) When vacuum test fails to meet 1 inch Hg drop in specified time after repair, repair and retest manhole.
3. Exfiltration Test:
 - a. Plug pipes in manhole; remove water in manhole; observe plugs over period of not less than 2 hours to ensure there is no leakage into manhole.
 - b. Determine ground water level outside manhole.
 - c. Fill manhole with water to within 4 inches of top of cover frame. Prior to test, allow manhole to soak from minimum of 4 hours to maximum of 72 hours; after soak period, adjust water level inside manhole to within 4 inches of top of cover frame.
 - d. Measure water level from top of manhole frame; at end of 4 hour test period, again measure water level from top of manhole frame; compute drop in water level during test period.

- e. Manhole exfiltration test is considered satisfactory when drop in water level is less than values listed in table below:

Manhole Depth (feet)	Allowable Leakage inches for Manhole Diameter		
	4 feet	5 feet	6 feet
4	0.11	0.14	0.17
6	0.17	0.21	0.26
8	0.23	0.29	0.35
10	0.28	0.35	0.42
12	0.34	0.43	0.51
14	0.40	0.50	0.60
16	0.45	0.56	0.68
18	0.51	0.64	0.77
20	0.57	0.71	0.86
22	0.62	0.78	0.93
24	0.68	0.85	1.02
26	0.74	0.93	1.11
28	0.79	0.99	1.19
30	0.85	1.06	1.28

4. When unsatisfactory test results are achieved, repair manhole and retest until result meets criteria; repair visible leaks regardless of quantity of leakage.

END OF SECTION

SECTION 33 05 14

PUBLIC MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-Place concrete manholes and structures with transition to cover frame, covers, anchorage, and accessories.
2. Modular precast concrete manholes and structures with tongue-and-groove joints with transition to cover frame, covers, anchorage, and accessories.
3. Doghouse manhole connections to existing storm sewer lines.
4. Bedding and cover materials.

B. Related Sections:

1. Section 31 05 13 - Soils: Soils for backfill in trenches.
2. Section 31 05 16 - Aggregates: Aggregate for backfill in trenches.
3. Section 31 23 16 – Excavation Fill: Excavating and backfilling for manholes, structures, and foundation slabs.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Manholes and Structures:

1. Basis of Measurement: By each manhole, catch basin, end section, head wall, flared pipe end.
2. Basis of Payment: Includes excavating, concrete foundation slab, concrete structure sections cover frame, PVC structure, grate and cover, to design depth, forming and sealing pipe inlets and outlets.

1.3 REFERENCES

A. American Association of State Highway Transportation Officials:

1. AASHTO M288 - Geotextiles.
2. AASHTO M306 - Drainage Structure Castings.
3. AASHTO M91 - Sewer and Manhole Brick (Made from Clay or Shale).

B. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements for Masonry Structures and Specifications for Masonry Structures.

C. ASTM International:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale).
4. ASTM C55 - Standard Specification for Concrete Brick.
5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

6. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
8. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
9. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
10. ASTM C1227 - Standard Specification for Precast Concrete Septic Tanks.
11. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
12. ASTM F1417 - Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.

D. Great Lakes - Upper Mississippi River Board:

1. Recommended Standards for Water Works (Ten State Standards)

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate structure locations, elevations, piping, sizes and elevations of penetrations.
- C. Product Data: Submit manhole covers, component construction, features, configuration, dimensions.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with IEPA and IECC Requirements and in accordance with IDOT Standard Specifications for Highway Construction.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Comply with precast concrete manufacturer's instructions and ASTM C913 for unloading, storing and moving precast manholes and drainage structures.
- C. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

- D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 CONCRETE MANHOLES AND STRUCTURES

- A. Furnish materials in accordance with IEPA, IECC and IDOT requirements.
- B. Manhole and Structure Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923. All structures and components shall be rated for a minimum H-25/HS-25 design load.
 - 1. Joints for Precast Manholes and Structures: In accordance with ASTM C913; maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.

2.2 PVC MANHOLES AND STRUCTURES

- A. Manufacturer's
 - 1. Nyloplast.
 - 2. Substitutions: (Per Preapproval by Engineer)
- B. Product Description:
 - 1. Shall be rated for a minimum H-25/HS-25 design load.
 - 2. Shall include area inlet top, concrete slab around top of structure, concrete sump infill and concrete anti-flotation collar (if necessary) per details.

2.3 FRAMES AND COVERS

- A. Furnish materials in accordance with IEPA, IECC and IDOT standards.
- B. Product Description:
 - 1. Lid and Frame: As shown on plans and rated for a minimum H-25/HS-25 design load.
 - 2. Grate and Frame: As shown on plans and rated for a minimum H-25/HS-25 design load.
 - 3. Substitutions: (Per Preapproval by Engineer)

2.4 ACCESSORIES

- A. Bituminous Interior Manhole Coating:
- B. Concrete: In accordance with IEPA, IECC and IDOT Standard Specification Section 501.

2.5 BEDDING AND COVER MATERIALS

- A. Bedding and Cover Type A2, as specified in Section 31 05 16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify items provided by other sections of Work are properly sized and located.
- C. Verify built-in items are in proper location, and ready for roughing into Work.
- D. Verify correct size of manhole and structure excavation.

3.2 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Do not install manholes and structures where site conditions induce loads exceeding structural capacity of manholes or structures.
- C. Inspect precast concrete and PVC manholes and structures immediately prior to placement in excavation to verify manholes and structures are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION - GENERAL

- A. Excavation and Backfill:
 - 1. Excavate for manholes and structures in accordance with Section 31 23 16 in location and to depth shown. Provide clearance around sidewalls of manhole or structure for construction operations, granular backfill.
 - 2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes or structures in dry trench.
 - 3. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation.
- B. Place foundation slab, trowel top surface level.
- C. Place manhole sections plumb and level, trim to correct elevations, anchor to foundation slab.
- D. Backfill excavations for manholes and structures in accordance with Section 31 23 16.
- E. Cut and fit for pipe.
- F. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel.
- G. Set cover frames and covers level without tipping, to correct elevations.

3.4 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION

- A. Lift precast manholes and structures at lifting points designated by manufacturer.

- B. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and manhole or structure remains clean.
- C. Set precast manholes and structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 31 23 16 or on other support system shown on Drawings.
- D. Assemble multi-section manholes and structures by lowering each section into excavation. Install rubber gasket joints between precast sections in accordance with manufacturer's recommendations. Lower, set level, and firmly position base section before placing additional sections.
- E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.
- F. Joint sealing materials may be installed on site or at manufacturer's plant.
- G. Verify manholes and structures installed satisfy required alignment and grade.
- H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Fill annular space with mortar.
- I. Cut pipe to finish flush with interior of manhole or structure.
- J. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel.

3.5 DOGHOUSE MANHOLE AND STRUCTURE INSTALLATION

- A. Stake out location and burial depth of existing sewer line in area of proposed manhole or structure.
- B. Carefully excavate around existing sewer line to adequate depth for foundation slab installation. Protect existing pipe from damage. Cut out soft spots and replace with granular fill compacted to 95% dry density.
- C. Prepare crushed stone bedding or other support system shown on Drawings, to receive foundation slab as specified for precast manholes and structures.
- D. Install pre-cast concrete or cast-in-place concrete manhole or structure around existing pipe in accordance with the appropriate paragraphs specified herein.
- E. Grout pipe entrances in accordance with IEPA, IECC and IDOT standards.
- F. Provide channel in accordance with IEPA, IECC and IDOT standards. Trowel smooth.

3.6 CASTINGS INSTALLATION

- A. Set frames using mortar and masonry as indicated on Drawings. Install radially laid concrete brick with 1/4 inch thick vertical joints at inside perimeter. Lay concrete brick in full bed of mortar and completely fill joints. Where more than one course of concrete brick is required, stagger vertical joints.

- B. Set frame and cover 2 inches above finished grade for manholes and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning below top surface of frame.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing. Testing shall include all necessary vacuum testing and infiltration/exfiltration testing as required. Perform Work in accordance with IEPA, IECC and IDOT standards.
- B. Test concrete manhole and structure sections in accordance with ASTM C497.
- C. Vertical Adjustment of Existing Manholes and Structures.
 - 1. Where required, adjust top elevation of existing manholes and structures to finished grades shown on Drawings.
 - 2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
 - 3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated on Drawings.
 - 4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with IEPA, IECC and IDOT standards.

END OF SECTION

SECTION 33 12 13

WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Pipe and fittings for domestic water service connections to buildings.
 2. Corporation stop assembly.
 3. Curb stop assembly.
 4. Unions.
 5. Underground pipe markers.
 6. Precast concrete vault.
 7. Bedding and cover materials.
- B. Related Sections:
1. Section 03 30 00 - Cast-In-Place Concrete.
 2. Section 31 05 13 - Soils for Earthwork.
 3. Section 31 05 16 - Aggregates for Earthwork.
 4. Section 31 23 16 - Excavation.
 5. Section 31 23 17 - Trenching.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. American Society of Mechanical Engineers:
1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- C. ASTM International:
1. ASTM A48/A48M - Standard Specification for Gray Iron Castings.
 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 4. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.
 5. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 6. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 7. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 8. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

9. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
10. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
11. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
12. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

D. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

E. American Water Works Association:

1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
2. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
3. AWWA C800 - Underground Service Line Valves and Fittings.
4. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in., for Water Service.
5. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittals Procedures: Requirements for submittals
- B. Shop Drawing:
 1. Installation Plan: Submit description of proposed installation.
- C. Design Data: Submit manufacturer's latest published literature to include illustrations, installation instructions, maintenance instructions and parts lists.
- D. Product Data: Submit data on pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, and accessories.
- E. Manufacturer's Certificates: Submit Statement of Compliance, supporting data, from material suppliers attesting that valves, hydrants, and accessories provided meet or exceed AWWA Standards and specification requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping mains, curb stops, connections, thrust restraints, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- D. Provide Operation and Maintenance Data for valves, curb stops and meters.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with AWWA standards;

1. C 508-01 Swing-Check Valves for Water Works
2. C 509-01 Resilient Seated Gate Valves
3. C 512-04 Air-Release, Air/Vacuum, and Combination Air Valves for Water Work Service
4. C701-07 Cold-Water Meter Turbine Type for Customer Service
5. C800-05 Underground Service Line Valves and Fittings
6. Perform work in accordance with NFPA standards. NFPA 281

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section.

B. Preference shall be given to American materials and manufacturers.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Prepare valves and accessories for shipment according to AWWA Standards and seal valve, and fitting open ends to prevent entry of foreign matter into product body.

C. During loading, transporting, and unloading of materials and products, exercise care to prevent any damage.

D. Store products and materials in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1. Coordinate storage areas with Owner as required

1.8 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.9 COORDINATION

A. Coordinate work with Owner.

1.10 MAINTENANCE MATERIALS

A. Furnish two tee type wrenches to Owner required length.

PART 2 PRODUCTS

2.1 WATER PIPING AND FITTINGS FOR WATER LINE UNDER 2 INCH

A. Copper Tubing: ASTM B88, Type K and L annealed

1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.

2. Joints: Compression connection or AWS A5.8, BCuP silver braze.
- B. PVC Pipe: ASTM D1785, Schedule 80
1. Fittings: ASTM D2466, PVC.
 2. Joints: ASTM D2855, solvent weld.
- C. Polyethylene Pipe: AWWA C901, SDR-9 or ASTM D2737, PE 4710, DR-9
1. Fittings: AWWA C901, molded or fabricated.
 2. Joints: Compression or butt fusion.

2.2 CORPORATION STOP ASSEMBLY

- A. Corporation Stops:
1. Brass or red brass alloy body conforming to ASTM B62.
 2. Inlet end threaded for tapping according to AWWA C800.
 3. Outlet end suitable for service pipe specified or required.
- B. Service Saddles:
1. Brass, double strap type, designed to hold pressures in excess pipe working pressure.

2.3 CURB STOP ASSEMBLY

- A. Curb Stops:
1. Brass or red brass alloy body conforming to ASTM B62.
 2. Ball type valve.
 3. Positive pressure sealing.
- B. Curb Boxes and Covers:
1. Cast iron body, Extension Type or Buffalo Type.
 2. Minneapolis or Arch Pattern Base.
 3. Lid with inscription WATER, with Pentagon Plug.

2.4 UNIONS

- A. Unions for Pipe 2 inches and Smaller:
1. Ferrous Piping: Class 150, malleable iron, threaded.
 2. Copper Piping: Class 150, bronze unions with soldered or brazed joints.
 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 4. PVC Piping: PVC.
 5. CPVC Piping: CPVC.
- B. PVC Pipe Materials: For connections to meters and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.5 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type specified in Section 03 30 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Determine exact location and size of water lines and valves from Drawings; obtain clarification and directions from Owner's Representative prior to execution of work.
- C. Verify building service connection and water main size, location, and inverts are as indicated on Drawings.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION - CORPORATION STOP ASSEMBLY

- A. Make connection for each different kind of water main using suitable materials, equipment and methods approved by the Owner's Representative.
- B. Provide service clamps for all mains.
- C. For plastic pipe water mains, provide full support for service clamp for full circumference of pipe, with minimum 2 inches width of bearing area; exercise care against crushing or causing other damage to water mains at time of tapping or installing service clamp or corporation stop.
- D. Use proper seals or other devices so no leaks are left in water mains at points of tapping; do not backfill and cover service connection until approved by the Owner's Representative.

3.4 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17 for Work of this Section.
- B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact to 95 percent.
- D. Place fill material in accordance with Section 31 23 23.

3.5 INSTALLATION - PIPE AND FITTINGS

- A. Install unions per this section to cut in and connect new proposed piping to existing piping. Install non-conducting dielectric connections wherever jointing dissimilar metals.

- B. Maintain separation of water main from sewer piping in accordance with IEPA Standards.
- C. Group piping with other site piping work whenever practical.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- E. Install access fittings to permit disinfection of water system performed under Section 33 13 00.
- F. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- G. Establish elevations of buried piping with not less than 42 inches of cover.
- H. Install trace wire continuous over top of pipe if piping is other than copper; coordinate with Section 31 23 23 and Section 31 23 17.
- I. Backfill trench in accordance with Section 31 23 23.

3.6 INSTALLATION - CURB STOP ASSEMBLY

- A. Set curb stops on solid concrete block that is bearing on compacted soil
- B. Center and plumb curb box over curb stops. Set box cover flush with finished grade.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush and disinfect system in accordance with Section 33 13 00.

3.8 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Pressure test system on domestic site water distribution system in accordance with AWWA C600 and Section 33 11 13.

END OF SECTION

SECTION 33 31 00

SANITARY UTILITY SEWERAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sanitary sewage pipe.
 - 2. Underground pipe markers.
 - 3. Manholes.
 - 4. Bedding and cover materials.
 - 5. Combination air valves.

- B. Related Sections:
 - 1. Section 31 05 13 - Soils: Soils for backfill in trenches.
 - 2. Section 32 05 16 - Aggregate: Aggregate for backfill in trenches.
 - 3. Section 31 23 16 - Excavation and Fill: Product and execution requirements for excavation and backfill required by this section.
 - 4. Section 31 23 17 - Trenching Backfill: Execution requirements for trenching required by this section.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

- B. ASTM International:
 - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - 2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 4. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - 5. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 6. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 7. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 8. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 9. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

- C. Great Lakes - Upper Mississippi River Board:

1. Recommended Standards for Water Works (Ten State Standards)

1.3 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.4 SUBMITTALS

- A. Section 01 30 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data indicating pipe material used, pipe accessories, manhole frames and lids, and precast concrete manholes.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution Requirements: Requirements for submittals.
- B. Project Record Documents: Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with IEPA, IECC and IDOT requirements.
- B. Maintain one copy of document on site.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements and elevations are as indicated on Drawings.

1.8 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate the Work with termination of sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.

PART 2 PRODUCTS

2.1 SANITARY SEWAGE PIPE

- A. Plastic Pipe: ASTM D3034, SDR 35, Type PSM, Poly (Vinyl Chloride) (PVC) material; inside nominal diameter as indicated on Drawings, bell and spigot style rubber ring sealed gasket joint.
 - 1. Fittings: PVC.
 - 2. Joints: Newest revision of AWWA C111 and ASTM D3212, push-on type, with elastomeric sealing gaskets meeting the newest revision of ASTM F477.

2.2 SANITARY SEWAGE LATERAL PIPE

- A. Plastic Pipe: ASTM D1785, Schedule 80, Type PSM, Poly (Vinyl Chloride) (PVC) material; inside nominal diameter as indicated on Drawings, bell and spigot socket style joint.
 - 1. Fittings: ASTM D2467, Schedule 80, PVC.
 - 2. Joints: ASTM D2855, socket weld.

2.3 UNDERGROUND PIPE MARKERS

- A. Metallic Ribbon Tape: Bright colored, continuously printed with “Sanitary Sewer Service” in large letters, minimum 6 inches wide by 4 mil thick capable of above grade magnetic location, manufactured for direct burial service.

2.4 MANHOLES

- A. Manhole Lid and Frame:
 - 1. Construction: Gray iron construction, solid lid.
 - 2. Lid Design: Heavy Duty, self-sealing with concealed pick holes.
 - 3. Frame: Heavy Duty, 9 inch height, 22 inch minimum clear opening.
- B. Shaft Construction and Eccentric Cone Top Section: Reinforced precast concrete as per ASTM C478, lipped male/female joints, ladder rungs cast into shaft sections spaced at 12 inches on center, nominal shaft diameter as indicated on Drawings.

2.5 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type as specified in Section 32 05 16.
- B. Cover: Fill Type, as specified in Section 32 05 16.
- C. Soil Backfill from Above Pipe to Finish Grade: as specified in Section 31 05 13, Section 31 23 16 and Section 31 23 17. Subsoil with no rocks over 4 inches in diameter, frozen earth or foreign matter.

2.6 COMBINATION AIR VALVE

- A. Combination air valve shall have the features of both an air release valve and an air and vacuum valve in a single body. The air release component shall be designed to automatically release small pockets of air to the atmosphere as they accumulate along a pipeline or piping system when it is full and operating under pressure. The air and vacuum component shall be designed to automatically discharge or admit large volumes

of air during the filling or draining of a pipeline or piping system. The valve will open to relieve negative pressures whenever water column separation occurs. The valve shall have unique design to enable the separation of the liquid from the sealing mechanism and assures working conditions. The valve shall be installed in existing location in existing concrete vault or in a heavy plastic meter tile with a cast iron line with sewer inscription. The valve shall have the following requirements:

1. Body - reinforced nylon
2. O-Ring - BUNA-N
3. Discharge outlet - polypropylene with debris/insect screen
4. Rolling seal - EPDM
5. Clamping stem - polypropylene
6. Float - foamed polypropylene
7. Extension - reinforced nylon
8. Base - reinforced nylon
9. Connection - male threaded 1/2" NPT

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify trench cut, excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over excavation with coarse aggregate.
- B. Remove large stones or other hard matter, which could damage pipe or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17.
- B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 8 inches.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with ASTM D2321. Seal joints watertight.
- B. Lay pipe to slope gradients noted on layout drawings; with maximum variation from indicated slope of 1/8 inch in 10 feet.
- C. Install bedding at sides and over top of pipe as indicated on Drawings.

- D. Refer to Section 31 23 17 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.
- E. Connect to building sanitary sewer outlet and municipal sewer system.
- F. Install locating plastic ribbon tape continuous over top of pipe, buried 6 inches below finish grade, above pipe line; coordinate with Section 31 23 17.
- G. Install site sanitary sewage system piping to 5 feet of building. Connect to building sanitary waste system.
- H. Install Work in accordance with IEPA, IECC and IDOT requirements and all federal, state and local standards and regulations.

3.5 INSTALLATION - MANHOLES

- A. Excavate for manholes in accordance with Section 31 23 16.
- B. Form bottom of excavation clean and smooth to correct elevation.
- C. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.
- F. Install Work in accordance with IEPA, IECC and IDOT requirements and all federal, state and local standards and regulations.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform test on site sanitary sewage system in accordance with IEPA, IECC and IDOT requirements. Referred to hereafter as Standard Specifications.
- C. Air Test: Test in accordance with IEPA, IECC and IDOT requirements.
- D. Deflection Test: Test in accordance with IEPA, IECC and IDOT requirements.
- E. Request inspection prior to and immediately after placing bedding.
- F. When tests indicate Work does not meet specified requirements, remove work, replace and retest.

3.7 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution Requirements: Requirements for protecting finished Work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 32 19

SANITARY SEWER PUMPING STATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sanitary sewer pumping stations.
 - 2. Initial operation of sanitary sewer pumping stations.

- B. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete.
 - 2. Section 26 05 00 - Basic Electrical Requirements.
 - 3. Section 26 05 13 - Wire and Cable.
 - 4. Section 26 05 15 - Medium-Voltage Cable and Accessories.
 - 5. Section 26 05 26 - Grounding and Bonding.
 - 6. Section 26 05 27 - Supporting Devices.
 - 7. Section 26 05 33 - Conduit and Boxes.
 - 8. Section 26 05 36 - Cable Trays.
 - 9. Section 26 05 53 - Electrical Identification.
 - 10. Section 26 24 16 - Panelboards.
 - 11. Section 26 27 26 - Wiring Devices.
 - 12. Section 26 28 16 - Disconnect Switches.
 - 13. Section 26 29 23 - Variable-Frequency Motor Controllers.
 - 14. Section 31 05 13 - Soils.
 - 15. Section 31 05 16 - Aggregates.
 - 16. Section 31 23 16 - Excavation Fill.
 - 17. Section 31 23 17 - Trenching Backfill.
 - 18. Section 31 25 13 - Erosion Control.

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.
 - 2. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

- B. American Concrete Institute:
 - 1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 2. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.

- C. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 4. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 6. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 7. ASTM A709/A709M - Standard Specification for Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy.
 8. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 9. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³).
 10. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³).
 11. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 12. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- D. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.
 2. AWS D1.4 - Structural Welding Code - Reinforced Steel.
- E. National Electrical Manufacturers Association:
1. NEMA MG 1 - Motors and Generators.
 2. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
 3. NEMA TC-2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
- F. National Electric Code:
1. NEC for clearances and wiring.
 2. NFPA 70 - National Electric Code.
 3. NFPA 79 - Electrical Standard for Industrial Machinery.
- G. Underwriters Laboratories Inc.:
1. UL 508A - Standard for Industrial Control Panels.
 2. UL 651 - Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
- H. Great Lakes - Upper Mississippi River Board:
1. Recommended Standards for Water Works (Ten State Standards)

1.3 SYSTEM DESCRIPTION

- A. Pumping Station: Provide and install duplex submersible pump station, field assembled, with wet basin, two submersible grinder pumps, automatic control, disconnects, electrical boxes and service, level sensors, valve vault, discharge connection, upper guide bar bracket, fit kit, guide rails, cable holder, floats, grip eye, chain sling, control panel with mounting system, gate valves, check valves, fittings, access doors, flanged DIP piping,

couplings, vent pipe, air/vacuum combination valve, electrical wiring, foundations and all appurtenances and minor details necessary to make the completed pump station fully operational.

1.4 PERFORMANCE REQUIREMENTS

- A. Pump Switch Operation:
 - 1. Locate four floats consisting of "common stop", "start lead", "start lag", and "high level" in basin. Start one pump automatically when "start lead" float is activated. Start second pump automatically when "start lag" float is activated. Signal alarm condition automatically when "high level" float is activated. Stop both pumps automatically when "common stop" float is activated. Set pumps to automatically switch operation from one pump to another after shut off of each pumping cycle.
- B. Sound, Vibration, and Thermal Control: Dampen or suppress noise, absorb vibration, accommodate thermal expansion and stresses, and adjust or correct for misalignment in piping systems.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate layout of pumping station. Show size, materials, and components of system. Indicate basin size, inlet and discharge location, cover dimensions, vent location, lifting cable location, valve pit and check valve location, union location, pump location, discharge piping location, junction box location, guide rail assembly location, level control locations, and ballast support flange dimensions.
- C. Product Data: Submit for each type of pumping station.
 - 1. Include catalog data for basin, cover, hinged door, slide rail assembly, lifting cable, basket strainer, discharge piping, valves, junction box, level controls, and control panel.
 - 2. Include pump catalog data, performance curve, breakaway fittings data, and access frame data.
 - 3. Include control panel data and panel wiring schematic.
- D. Test Reports:
 - 1. Submit written report showing factory pump inspections and tests have been successfully performed.
- E. Manufacturer's Installation Instructions: Submit manufacturer's published installation instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Manufacturer's Field Reports:
 - 1. Submit report of each visit of manufacturer's representative to provide technical assistance during installation.
 - 2. Submit start-up report before final acceptance of pumps to document pumping station operation meets performance requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Record actual locations of pumping stations including basins and control panel.
- C. Submit executed certification of pumping stations after performance testing.
- D. Submit spare parts list and rebuild kits.
- E. Provide Operations and Maintenance Manual containing operating and maintenance requirements for pumping station and schedule of recommended maintenance.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with IEPA, IECC and IDOT requirements.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.
- C. Design pumping station under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Illinois.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials and water by temporary covers, completing sections of work, and isolating parts of completed system.
- D. Accept system components on site in manufacturer's original containers or configuration. Inspect for damage.
- E. Store sensitive materials for field assembly in dry area in original shipping containers.
- F. Support basin with nylon slings to structural lift points during handling.
- G. Repair damage to basin according to manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

- B. Do not install basin when bedding is wet or frozen. Dewater excavation to keep excavation dry.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Bedding, Ballast, and Backfill.
 - 1. Bedding: Aggregate Type as specified in Section 31 05 16.
 - 2. Aggregate Ballast and Backfill: Aggregate Type as specified in Section 31 05 16.
 - 3. Soil Backfill to Finish Grade: Soil Type as specified in Section 31 05 13. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.2 BASIN SYSTEM

- A. Product Description:
 - 1. Submersible duplex basin system including cover with vent and door, rail assemblies, discharge and fittings, unions, junction box, and level controls.
 - 2. Inlet Size: 4 inches.
 - 3. Discharge Size: 4 inches.
- B. Wet Basin:
 - 1. Fiberglass reinforced plastic wet basin with anti-flotation flange and reinforced concrete anti-flotation ring. Construction basin using 0 to 90 degrees laminate construction method conforming to requirements specified in ASTM D3299, ASTM D4097 and meeting Acceptance Level II requirements of ASTM D2563; 0 to 90 degrees laminate construction is defined as basin having continuous circumferential hoop fibers running at 0 degrees with two layers of axial fibers installed approximately 90 degrees to hoop wind.
 - 2. Use materials of construction to resist and retain fluid without leakage or damage to structural integrity of basin; use same resin throughout construction of each tank. Furnish nexus or C-veil to meet requirements.
 - 3. Vertical, non-sloping flat bottom, galvanized steel cover with hinged and lockable access hatch.
 - 4. Basin shall be placed on reinforced concrete base pad on a compacted aggregate base on a prepared compacted subgrade.
 - 5. Minimum wall thickness: Per manufacturer requirements.
 - 6. Diameter: 6 feet (72 inches).
 - 7. Depth: 12 feet (144 inches).
- C. Valve Vault:
 - 1. Fiberglass reinforced plastic valve vault. Construction basin using 0 to 90 degrees laminate construction method conforming to requirements specified in ASTM D3299, ASTM D4097 and meeting Acceptance Level II requirements of ASTM D2563; 0 to 90 degrees laminate construction is defined as vault having

- continuous circumferential hoop fibers running at 0 degrees with two layers of axial fibers installed approximately 90 degrees to hoop wind.
2. Use materials of construction to resist and retain fluid without leakage or damage to structural integrity of vault; use same resin throughout construction of each tank. Furnish nexus or C-veil to meet requirements.
 3. Vertical, sloping bottom back to wet basin, galvanized steel cover with hinged and lockable access hatch.
 4. Vault shall be placed on reinforced concrete base pad on a compacted aggregate base on a prepared compacted subgrade.
 5. Minimum wall thickness: Per manufacturer requirements.
 6. Dimensions: 4 feet diameter x 4 feet flat wall (48 inches diameter x 48 inches flat wall).
 7. Depth: 4 feet (48 inches).
- D. Wet Basin and Valve Vault Covers: One pieces tread plate galvanized steel ASTM A36 covers reinforced to support a minimum H-25/HS-25 design load including steel curb frame with anchor legs, hinged and lockable access hatches and reinforced concrete pad.
- E. Access Hatch:
1. The wet basin shall have 29" x 39" access hatch. The valve vault shall have 24" x 36" access hatch. The access hatches shall be single leaf, lockable and pre-assembled from the manufacturer.
 2. 1/4 inch thick aluminum with diamond pattern, stainless steel hinges, anchor flange, drainage coupling and zinc plated hardware. Reinforced to support minimum uniform live load to 300 psf or a minimum H-25/HS-25 design load, whichever is greater. Hatch shall be insulated with a minimum of one inch of fiberglass insulation, covered and protected by an 18 gauge aluminum liner.
 3. Extruded aluminum angle frame with mitered corners and steel strip anchors.
 4. Torsion bar assist, lock open at 90 degrees, slam lock, removable key wrench outside, attached inside handle.
 5. Neoprene, watertight closure gasket.
- F. Rail System: Slide rail assemblies consisting of 304 stainless steel upper and lower rail brackets and pump guide brackets. Slide rail, lifting chain and all brackets shall be stainless steel.
- G. Junction Box: NEMA 250 Type 6 with cable grips for incoming underground cable.
- H. Electrical:
1. Provide cable grips for underground cable for field installation.
 2. Provide explosion proof equipment, supplies and fittings.
- I. Level Controls: Four mechanical float type or mercury type pilot duty liquid level controls with AWG 18-2 SJOW-A cable in polypropylene housing for mounting to support float pole.
- J. Debris Basket: A debris basket shall be installed inside the sanitary sewer pumping station on the influent pipe. The basket shall be a perforated screen style basket and be aluminum with aluminum tracking angles as part of the basket frame. The guide rails shall be extruded aluminum channels sized to facilitate easy operation of the basket. An aluminum basket stop shall be supplied.

2.3 PIPING

- A. Ductile Iron Pipe: Newest revision of AWWA C151, Class 350 and wall thickness AWWA C150:
 - 1. Fittings: Compact fittings, newest revision of AWWA C153 ductile iron, standard thickness, rubber gasket flanged joint.
 - 2. Flanged Joints: Newest revision of AWWA C115.
 - 3. Lining: Newest revision of AWWA C104, cement-mortar lining.
 - 4. Jackets: Newest revision of AWWA C105, polyethylene jacket.

- B. Flange Adapters
 - 1. Flange adapters shall consist of gray cast iron flanges for 12” and smaller pipes, steel flanges for pipe that is larger than 12” with ductile iron follower flanges. The bolt circle, bolt size and spacing shall conform to ASME/ANSI B16.1 - 1998 - Cast Iron Pipe Flanges and Flanged Fittings for 125-pound flanges.
 - 2. Gaskets used shall be of the synthetic rubber type.
 - 3. “O” rings shall be neoprene.
 - 4. Each flange adapter shall be furnished with four or more anchor studs where noted on the plans.

- C. Kwik Flange
 - 1. The Kwik Flange shall be designed for use on ductile iron piping.
 - 2. The unit shall be provided with setscrews giving restraint against the pressure force and shall have both Underwriter’s Laboratories, Inc. and Factory Mutual Research Corp. approval. It shall be as manufactured by Standard or approved equal.

- D. Service Connections on Internal Piping
 - 1. All plumbed devices within the wet basin and valve vault eventually requiring service shall be easily removed from the piping by the presence of appropriately placed and sufficient quantity of adaptors and couplings as necessary.

- E. Pipe Supports
 - 1. Components of the bracket assembly shall be carbon steel with a stainless steel 316 U-bolt in accordance with the associated standards.
 - 2. The bracket assembly shall provide a minimum of 2” of adjustment for alignment of the pipe section with the connection to the piping.
 - 3. The bracket assemblies shall consist of four components:
 - a. A base plate weldment that consists of a base plate with a center-located tubular guide.
 - b. A top-works weldment that consists of a structural channel and angle iron to provide 120° contact area with the pipe, and a center-located pipe stub welded to the bottom of the support plate. The piping shall rest on the angle iron. The angle iron has predrilled holes for the U-bolt.
 - c. U-bolt(s) with four hex nuts for the top-works.
 - d. An 1/8” thick EPDM strip with a length equivalent to the circumference of the pipe. The strip shall be placed between the pipe and the angle iron and U-bolt.
 - e. The pipe stub shall be inserted into the tubular guide of the base plate weldment during installation of the assemblies.

4. The support shall be anchored to the floor with stud type expansion anchors, the pull-out rating of the combined anchors shall be a minimum of 10 times greater than the static weight of the pipe section.
 5. The base plate weldment and top-works weldment shall be joined by field welding following proper adjustment of the assembly.
 6. Plastic insulating sleeve/washers shall be utilized to isolate dissimilar metals where required.
 7. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
- F. Provide check valve with hydraulically sealed coupling, and gate valve with stem extension in each pump discharge line.
1. Check Valve: Combination horizontal spring-loaded type; iron body, bronze mounted; stainless steel pine and spring; renewable disc; flanged.
 2. Gate Valve: See Section 33 12 16; flanged.

2.4 PUMPS

- A. Manufacturers:
1. Sulzer ABS
 2. Xylem Flygt.
 3. Pentair Myers
 4. Pentair Fairbanks Morse/Nijhuis.
 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description:
1. Pumps: Submersible grinder effluent constant speed with vertical discharge, fittings, piping, check valve, and pump brackets.
 2. Each pump shall be equipped with submersible electric motor connected for operation on 208 wye volts, 3 phase, 60 hertz, from VFD phase conversion service, with sufficient length of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and have P-MSHA Approval. The pump shall be supplied with a mating cast iron discharge connection. Each pump shall be fitted with grip eye systems. The working load of the lifting system shall be 50% greater than the pump unit weight.
 3. The pump shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet basin. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring, or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Two hold down brackets shall be provided to prevent pump and seal fitting from rising on rails.
 4. Power and float cable supports shall be provided.
 5. Pump, motors and wiring shall meet NEMA Class 1, Group D, Division 1 requirements.
- C. Pump Construction:

1. Major pump components shall be of cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
2. Sealing design with the pump shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
3. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.
4. The motor construction shall be designed to meet Factory Mutual requirements for Class 1, Division 1, Groups C and D sewage applications. The model shall be certified and nameplated with this approval. The motor chamber and seal chamber shall be filled with a high dielectric type oil for improved lubrication and heat transfer of the bearings and motor. An air space above the oil level in both the seal and motor chambers shall be provided to allow for the expansion of the oil when at operating temperature. The power and control lines shall be sealed and strain relieved on the outside entrance with a standard cord grip, and internally through the use of a dielectric potting resin surrounding the electrical wires. All of the pump fasteners and shafts shall be made from corrosion resistant stainless steel, while the pump castings are made of ASTM A-48 Class 30 cast iron, and the multivane vortex impellers shall be made from ductile iron.

D. Cooling System:

1. Each pump/motor unit the motor chamber and seal chamber are dielectric oil-filled for good heat transfer and lubrication of bearings and seals. The motor requires no other lubrication. Oil level in the motor housing should be to the bottom of the oil fill plug with the pump in a vertical position, ensuring the upper bearing is submerged in oil. Do not overfill the motor housing since some space is required for oil expansion. Oil level in the seal chamber should be checked with the pump lying horizontally with the fill plug at the top. The oil level should be approximately 3/4" from the outside surface of the housing. Transformer oil should be used and may be purchased from the pump manufacturer.

E. Cable Entry Seal:

1. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of the sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

F. Motor:

1. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 356 degrees F. The stator shall be insulated with Class H monomer free polyester resin. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 104 degrees F and capable of up to 15 evenly spaced starts per hour. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 206 degrees F shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. Wire nuts or crimping type connection devised are not acceptable. The motor and pump shall be designed and assembled by the same manufacturer.
2. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15.
3. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 104 degrees F ambient and with a temperature rise not to exceed 80 degrees C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. The chart shall also include data on starting and no-load characteristics.
4. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
5. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

G. Bearing:

1. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently lubricated. The upper bearing shall be a single deep grooved ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.
2. The minimum B₁₀ bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.
3. The lower bearing house shall include an independent thermal sensor to monitor the bearing temperature. If a high temperature occurs, the sensor shall activate an alarm and shut the pump down.

H. Mechanical Seal:

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The lower seal shall be

independent of the impeller hub. The seals shall operate in a lubricant reservoir that hydrometrically lubricate the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump the lubricant chamber, shall contain one stationary and one positively driven rotating tungsten carbide seal ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary tungsten-carbide seal ring and one positively driven rotating tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal. For special applications, other seal face materials shall be available.

2. Should both seals fail and allow fluid to enter the stator housing, a port shall be provide to direct that fluid immediately to the stator float switch to shut down the pump and activate an alarm. Any intrusion of fluid shall not come into contact with the lower bearings.
3. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower lead faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to affect sealing shall be used.
4. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.
5. Seal lubricant shall be FDA Approved, nontoxic.

I. Pump Shaft:

1. Pump and motor shaft shall be the same unit. The pump shaft shall be an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be AISI Type 420 stainless steel.

J. Impeller:

1. The impeller shall be of gray cast iron, ASTM A-48, Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaning automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

K. Volute/Suction Cover:

1. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as

specified. The volute shall have integral spiral-shaped, sharp-edge grooves that are cast into the suction cover. The spiral grooves shall provide the sharp edges across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute.

L. Grinder Assembly:

1. The pump shall be of centrifugal type with the rotating cutter mounted on the pump shaft directly against the impeller. The stationary cutter shall be mounted in an adjustable bottom plate. The stationary cutter shall have slots to facilitate better flow. The bottom plate shall be cast with grooves threading outward from the center opening of the plate to the outer diameter. The cutter material shall be similar to an ANSI 440C stainless steel with the addition of cobalt, vanadium, and molybdenum for superior abrasion resistance and a hardness of 58-60 Rockwell C.

M. Protection:

1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 260 degree F the thermal switches shall open, stop the motor and activate an alarm.
2. A lower bearing temperature sensor shall be provided. The sensor shall directly contact the outer race of the thrust bearing providing for accurate temperature monitoring.
3. A leakage sensor shall be provided to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. Use of voltage sensitive solid state sensors and trip temperature above 260 degrees F shall not be allowed.
4. The thermal switches and FLS shall be connected to a monitoring unit. The monitoring unit shall be designed to be mounted in the control panel.

N. Pump Accessory Equipment:

1. To permit quick removal and reinstallation of the pump and motor assembly without requiring unbolting or other similar form of disconnection of the pump discharge piping the following components shall be provided.
 - a. For each pump a cast iron 90 degree discharge base elbow shall be supplied. This elbow shall have a standard 150 pound flanged discharge connection. In addition, the elbow shall incorporate mounting sockets for two pump guide rails. Guide rails shall be Schedule 40, 316 stainless steel pipe or equal.
 - b. In addition, stainless steel upper guide rail holder bracket shall be provided by the pump supplier for anchoring the top of the pump guide rails. Stainless steel intermediate brackets shall be provided by pump supplier as needed.
 - c. The pump shall be equipped with a sliding guide bracket, which shall be pivoted and bolted to the pump frame in a manner such that when the pump is resting in the fully lowered position on the discharge base elbow the force applied between the pump and the elbow flange faces shall be at least three times the net weight of the pump and motor assembly to ensure a tight fit of these flanges.

- d. Grip eye system or approved equal shall be provided and installed for each pump.
 - e. Provide pump cable holder for each pump.
- O. Pump Duty Points and Requirements:
- 1. Number of pumps = 2 submersible grinder
 - 2. Discharge Elbow = 4 inch
 - 3. Horsepower = 3 (208 wye volts, 3 phase)
 - 4. Flow Capacity/TDH = 100 gpm @ 34 ft TDH
 - 5. Efficiency = minimum 65%

2.5 CONTROL PANEL

- A. Product Description.
- 1. All motor controls and control components shall be supplied by a single supplier. Control panel shall be manufactured by a UL 508A listed panel shop.
 - 2. The control equipment shall be mounted in a single weatherproof cabinet (NEMA 3R) dead front enclosure. The cabinet shall be pad lockable. The cabinet shall be suitable for wall or post mounting. Entry to cabinet shall be via a rotating quarter turn latch, one per door. Each door shall have a door stop to allow locking the door in an open position.
 - 3. All control wiring within the control cabinet shall be flexible, stranded type and each conductor shall be tagged and numbered in accordance with the manufacturer's wiring diagram. All outgoing wires shall be connected to terminal strips. Solderless connectors shall be used throughout to facilitate maintenance. All components shall be identified in accordance with the wiring diagram, and all operating controls and panel mounted components such as gauges, indicating lights, switches, etc., shall be identified by printed labels.
 - 4. The wiring shall comply with the National Electric Code and applicable state and local does. Wiring shall be completely factory installed except for the wires that run to connection points external to the control panel.
 - 5. The cabinet shall be provided with a thermostatically controlled strip heater for condensation and thermal protection. The strip heater shall be rated for not less than 200 watts.
 - 6. As part of the control cabinet, an electrical distribution center consisting of individual thermal-magnetic circuit breakers, properly sized, shall be provided for each branch circuit. Combination circuit breaker and overload mechanism shall not be allowed. Circuit breakers shall have a minimum rating of 10,000 AIC (230 vac breakers) ~~or~~ 14,000 AIC (480 vac breakers). Branch circuits shall be provided including the following:
 - a. Surge suppression shall be provided for surge protection on each phase and mode as specified.
 - b. The control circuitry shall include, and under voltage, phase sequence and phase loss relay which shall prevent pump operation in the event the voltage level is insufficient, or the wrong rotation or a phase is lost. This relay shall include a two (2) second time delay to prevent nuisance shut downs. The voltage level and phase rotation shall be at an acceptable level for a predetermined time before allowing the motor to start, (provide Adjustable Time Delay, adjustable between 5 and 30 seconds). A warning light shall be illuminated to indicate when insufficient voltage is present for starting the motor.

- c. Individual thermal magnetic circuit breakers shall be provided for branch disconnect service and overcurrent protection of all motor and auxiliary circuits. Provide auxiliary circuit breakers for:
 - 1) Valve Vault Equipment (light and convenience receptacle with GFI).
 - 2) Strip Heaters/enclosure light.
 - 3) Pump Controls.
 - 4) Convenience Receptacle with GFI (remote mounted).
 - 5) Seal Failure circuit.
 - 6) Telemetry System.
 - 7) Spare.
 - 8) Spare.
 - d. The circuit breakers shall indicate when the circuit is open and shall have means provided for manual switching. All breakers shall be labeled as to function with printed labels.
7. Mounted in the control panel each pump shall be provided with an MCP type magnetic, full voltage non-reversing, NEMA rated, combination motor starter sized per article 430 of the NEC or as shown on the drawings with Class 10 ambient compensated overload relays for each leg to give positive protection. Overload reset shall be through the inner door. All motors over 40 Hp shall be provided with a solid state "soft start" reduced voltage starter. Unit shall be capable of soft start and stop with adjustable times from 0 to 30 seconds minimum. Starting voltage shall be adjustable 30%-70% minimum. Unit shall have an up to speed contactor and overload relay sized as above. Provide shielding and harmonic suppression to prevent interference with the telemetry system. If unit provide functions similar to the under voltage monitor specified above, then an under voltage monitor will not be required.
 8. Time delay relays shall be dial or D.I.P. switch selectable, and shall have contact ratings of not less than 10 amps. Switch settings shall be labeled on the relay.
 9. Control relays shall be general purpose plug-in relays with standard mounting configurations. The relays shall have the number of poles as shown on the drawings with neon indicating lamp and test button integral to each relay. Relay contact ratings shall be minimum 5 amps.
 10. Provide an automatic electronic alternator for alternating pump operation on successive automatic cycles. Relay shall incorporate LED position indicators and a toggle switch to select pump #1 or pump #2 as the lead pump, or to allow automatic alternation.
 11. Duplex GFI receptacle rated 120 volts, 20 amps shall be provided. It shall be externally mounted remote from the enclosure in the valve vault.
 12. An interior swing panel of the cabinet shall be provided. Door shall be made of painted steel of a gauge to provide suitable rigidity with a latch to keep the inner closed and have the following indicators:
 - a. Green pump running lights for each pump, each speed.
 - b. Non-resettable elapsed time meter for each pump.
 - c. Red stator over temperature indicator.
 - d. Amber seal failure indicator for each pump.
 - e. Red low voltage/phase reversal light.
 - f. Red motor overload trip for each pump.
 - g. Red high water level.
 All alarm and status lights to be push-to-reset type, 30mm, industrial, oil tight with cluster LED lamps.

13. The interior swing panel of the cabinet shall have the following industrial, oil tight 30 mm operators:
 - a. 3 Position hand-off-auto selector switch for each pump.
 - b. Manual reset push button for each pump.
 - c. Test push button for each float (4 floats).
 - d. ON/OFF paddle switches for each alternator.
 - e. Alarm reset pushbutton.
 - f. Alarm horn silence pushbutton.
 - g. Motor overload reset.

Overload and high temperature alarms shall require manual reset. A single button to reset each pump is acceptable.
14. To control the sequence of operation of the pump with variations of wastewater level, float type switches shall be provided. Provide weighted anchors with each float to avoid pump jogging.
 - a. The control sequence shall be:
 - 1) Level 1 - All pumps OFF/Alternate.
 - 2) Level 2 - Start lead pump.
 - 3) Level 3 - Start lag pump.
 - 4) Level 4 - High water alarm.
 - b. The control system shall also provide automatic fail over to the lag pump should the lead pump fail based on the following:
 - 1) Pump overload.
 - 2) Pump over temperature.
 - c. The control system shall include programming that only one pump will operate at a time. To accomplish this a mechanical interlock shall be installed so that the dual pump control system can only operate one motor at a time. The only time the lag pump will operate is if the lead pump fails. At no point shall both the lead and lag pumps operate at the same time.
15. The controls shall be equipped with a weatherproof vandal resistant red flashing alarm light with protective guard mounted externally on top of the enclosure. Minimum rating shall be 1.5 Joules at 70 flashes per minute. The light shall be illuminated and flashing only under an alarm condition. Unit shall have a battery backup to allow operation of the strobe during a power outage for up to 8 hours. Unit shall maintain NEMA 3R rating of enclosure. Also, provide a weatherproof alarm horn mounted to the side, exterior of the enclosure. Output shall be adjustable between 78 and 103 dB at 10 feet. The following alarms shall initiate the strobe:
 - a. Stator over temperature indicator.
 - b. Low voltage/phase reversal.
 - c. Motor overload trip for each pump.
 - d. High water level.
 - e. Power failure.
16. The controls shall be equipped with dry contacts for remote monitoring to alert personnel designated by the Owner, of the following alarms generated by the pumping station controls:
 - a. Pump failure alarm.
 - b. High water level alarm.
 - c. Power abnormality or failure.
 - d. Surge suppressor failure.
17. Labels/Nameplates

- a. All components shall be identified according to wiring diagram.
 - b. Provide adhesive backed printed labels for all internal devices such as contactors, circuitry breakers and relays. Labels shall be adhered to the subpanel. No labels shall be adhered to wire cover.
 - c. Provide engraved phenolic nameplates, with black letter on white background, for door-mounted device such as selector switches, push-buttons, circuit breaker toggles and pilot lights. Nameplates shall be secured firmly to the panel.
18. The pump control manufacturer shall provide a laminated copy of the final “as-wired” control drawing mounted on the inside of the enclosure door.
 19. The enclosure shall be equipped with an incandescent lighting package Hoffman A-LTMB1 or equivalent.
 20. The control panel door shall include a plastic pocket on the interior to hold one (1) copy of the panel wiring diagram. The wiring diagram shall be corrected “as-wired” copy and contain individual wire numbers, circuit breaker number, switch designations and control function explanations.
 21. The wet basin has been classified as a Class 1, Group D, Division 1 location. All control equipment such as floats to be used within the wet basin, as well as individual pump leak detection and cover temperature detection circuits (if required), shall be designed and installed for intrinsically safe operation per Article 054 of the NEC.
 22. The enclosure shall also include a corrosion inhibitor foam device, to be installed after startup.
 23. The wet basin shall be equipped with a float switch cable hanger attachment with individual float switch level adjustments.
 24. The pumps’ power and control cables shall be supported by Kellems type grip and attached in a convenient manner at the pump hatch.
 25. Provide a VFD phase conversion unit for each pump to convert the single phase service to three phase power for pump operation. Units shall be mounted inside the enclosure. Unit shall be provided with appropriate overcurrent protection.
 26. The control panel shall be protected by a conduit seal to prevent any gases from the wet basin from gaining access to the control panel. The seal shall be located so that the motor may be removed and electrically disconnected without disturbing the seal.

2.6 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Perform the following factory inspections and tests:
 1. Motor voltage and frequency check as shown on name plate.
 2. Motor and cable insulation test for moisture content or insulation defects in accordance with UL criteria.
 3. Submerged pump run test to determine pump meets hydraulic performance requirements.
- C. Make completed basin, pump, and control panel systems available for inspection at manufacturer’s factory prior to packaging for shipment. Notify Owner at least seven days before inspection is allowed.

- D. Allow witnessing of factory inspections and test at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify inlet and discharge piping connection are size, location, and elevation on Drawings.

3.2 EXCAVATION

- A. Excavate underground cable trench in accordance with Section 31 23 17.
- B. Excavate to required elevation to install basin on undisturbed subgrade in accordance with Section 31 23 16 with minimum clearance of 4 inches between basin and surrounding earth.

3.3 BASIN AND VAULT INSTALLATION

- A. Place, compact and level aggregate bedding to minimum 12 inches on a prepared compacted subgrade.
- B. Form and place reinforced concrete base pad, trowel top surface level.
- C. Install basin and vault at proper grade and to alignment on Drawings on reinforced concrete base.
- D. Install concrete anti-flotation ring on basin anti-flotation flange.
- E. Set cover frames and covers level without tipping, to correct elevations.
- F. Assemble basin components including inlet hub/fitting, discharge hub, cover, pump support rail system, level controls, and junction box.
- G. Connect to inlet and discharge piping with flexible connector.
- H. Seal joints water tight between inlet and discharge pipes and sump wall.

3.4 PUMP INSTALLATION

- A. Install pump including fittings, brackets, discharge piping, check valve to basin rail assembly, lifting device, and discharge. Wire pump to junction box.

3.5 CONTROL PANEL INSTALLATION

- A. Mount and wire control panel for pumping station operation including duplex motor controls, circuit breaker, starter, control transformer, fuse box, terminal block, alternator, alarm and running lights.
- B. Wire in accordance with requirements of National Electrical Code.
- C. Number each conductor.
- D. Locate and connect underground cable from control panel to basin junction box.
- E. Provide steel mounting channels and attaching hardware to properly balance and secure the control panel in strict accordance with the equipment manufacturer's recommendations.
- F. Provide equipment grounding connection for pump control panel.

3.6 BACKFILL

- A. Backfill basin and underground cable in accordance with Section 31 23 23.
- B. Maintain optimum moisture content of fill material to attain required compaction density.
- C. After hydraulic test, evenly backfill around entire periphery of basin by hand placing backfill material and hand tamping in 6 inches compacted layers to finish grade. Compact to 95 percent maximum density.
- D. Do not use wheeled or tracked vehicles for tamping.

3.7 STATION STARTUP, INITIAL TESTING AND OPERATION

- A. Notify Architect/Engineer 3 days prior to flow rate testing.
- B. Provide startup and initial testing of system. Coordinate and operate pumps in conjunction with other construction.
- C. Hydraulically test station to performance requirements by receiving, pumping and discharging 500 gallons of water to/from basin.
- D. Correct failures during test by repairing or replacing malfunctioning parts or equipment or faulty workmanship, regardless of cause, within 48 hours after notification from Architect/Engineer.
- E. After correcting failures caused by defective equipment, material, or faulty workmanship, retest until failures are eliminated.
- F. Confirm general sequencing of pump and float operations at basin and control panel are in accordance with performance requirements.
- G. Document and certify startup results in start up report.

3.8 COMPACTION TESTS

- A. Section 01 40 00 - Quality Requirements.
- B. Compaction Testing: As specified in Section 31 23 23.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.9 MANUFACTURER'S FIELD SERVICE

- A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish factory trained representative and field technical assistance during the following periods of pumping station installation:
 - 1. Unloading of station materials and components.
 - 2. Start-up, testing, and demonstration of station systems-basin, pump, and control panel.

3.10 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust basin, pump, and control panel systems so station operates to performance requirements and in accordance with specifications.

3.11 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate operation of pumping station - basin components, pump system, and control panel.

3.12 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

END OF SECTION

SECTION 33 34 00

SANITARY UTILITY SEWERAGE FORCE MAINS

1. GENERAL

1.1 WORK INCLUDES

A. Base Bid:

1. Plumbing Contractor provide:
 - a. Force mains.
 - b. Bedding and cover materials.

B. Related Requirements:

1. Section 31 05 13 - Soils.
2. Section 31 05 16 - Aggregates.
3. Section 31 23 17 - Trenching Backfill.
4. Section 33 01 32 - Sewer and Manhole Testing.
5. Section 33 32 19 - Sanitary Sewer Pumping Stations.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
3. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
4. ASTM D2241 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
5. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
6. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
7. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. American Water Works Association:

1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
3. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

1.3 COORDINATION

- A. Coordinate the Work with connection to existing Public Works, and trenching.

1.4 SUBMITTALS

- A. Product Data: Submit data indicating pipe material used, pipe accessories, and air release valves.
- B. Shop Drawings: Submit shop drawings for PVC piping. Indicate piece numbers and locations.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- D. Manufacturer's Instructions: Indicate special procedures required to install Products specified.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record location of pipe runs, connections, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with IEPA.
- B. Maintain one copy of each document on site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not place materials on private property without written permission.

- B. During loading, transporting and unloading, exercise care to prevent damage to materials.
- C. Do not drop pipe or fittings.
- D. Avoid shock or damage to pipe.
- E. Take measures to prevent damage to exterior surface or internal lining of pipe.
- F. Do not stack pipe higher than recommended by pipe manufacturer.
- G. Store gaskets for mechanical and push-on joints in cool, dry location out of direct sunlight and not in contact with petroleum products.

1.8 EXISTING CONDITIONS

- A. Verify field measurements prior to fabrication. Indicate field measurements on shop drawings.

2. PRODUCTS

2.1 FORCE MAIN

A. POLYVINYL CHLORIDE (PVC) PIPE

B. PVC Pressure Sewer Pipe and Fittings - 12" Nominal Pipe Size and Smaller:

1. ASTM D2241, PVC 1120 (12454) or PVC 1220 (12454) or PVC 2120 (14333); SDR 21.
2. ASTM D1785, Schedule 80, with fittings conforming to ASTM D2467.

C. UNDERGROUND PIPE MARKERS

D. Trace Wire: Electronic detection materials for non-conductive piping products.

1. 12 AWG High Strength Soft Drawn 380# insulated copperhead wire.
 - a. Mount Tracer Wire to top of pipe with duct tape every 20 feet.

E. BEDDING AND COVER MATERIALS

F. Soil Backfill from Above Pipe to Finish Grade: as specified in Section 31 05 13.

G. CONCRETE

H. Concrete in accordance with Section 03 30 00.

3. EXECUTION

3.1 EXAMINATION

- A. Verify trench cut and excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over excavation with fine aggregate.
- B. Remove large stones or other hard matter capable of damaging pipe or impeding consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31 23 17.
- B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches.
- C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

- A. Install pipe, fittings, and accessories in accordance with Drawings.
- B. Route piping in straight line.
- C. Install bedding at sides and over top of pipe to minimum compacted thickness of 12 inches.
- D. Refer to Section 31 23 17 for backfilling and compacting requirements. Do not displace or damage pipe when compacting.
- E. Connect to municipal sewer system.

3.5 INSTALLATION - THRUST RESTRAINT

- A. Provide pressure pipeline with restrained joints or concrete thrust blocking at bends, tees, and changes in direction; construct concrete thrust blocking in accordance with Drawings.

3.6 INSTALLATION - CRADLES AND ENCASEMENT

- A. Provide concrete cradles and encasement for pipeline where indicated on Drawings as specified in Section 03 30 00.

3.7 FIELD QUALITY CONTROL

- A. Perform test on site sanitary sewage system in accordance with local code standards.
- B. Pressure Test: Test in accordance with Section 33 01 32.
- C. Infiltration Test: Test in accordance with Section 33 01 32.
- D. Deflection Test: Test in accordance with Section 33 01 32.
- E. Request inspection prior to and immediately after placing bedding.
- F. When tests indicate Work does not meet specified requirements, remove work, replace and retest.

3.8 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION